PRACTICAL ENGINEER

Trade-mark reg. U. S. Pat. Office

SEMI-MONTHLY

VOL. XIX. CHICAGO, OCTOBER 1, 1915 No. 19

Meeting Diversified Requirements

POWER GENERATING EQUIPMENT IN LOOSE-WILES BISCUIT CO'S. NEW BAKERY REPRESENTATIVE OF MODERN ISOLATED PLANT PRACTICE

ANYONE HAPPENING TO BE A New York visitor will be well repaid for the time and effort expended in making a visit to the new Long Island City bakery of the Loose-Wiles Biscuit Co., manufacturer of the famous Sunshine products. Crossing Queensboro Bridge, which connects New York City with Long Island City, the visitor will see in the distance, to his right, the new 9-story fire-proof structure of the above-named company, which, with its white enameled brick walls, appears to stand out as a monument to cleanliness when compared with the dull gray of the surrounding structures and smoke-laden sky. Leaving the car at the Long Island approach of the bridge, this interesting manufactory, the products of which are known from coast to coast, is but a few squares away, consequently within easy walking distance.

After having been guided through the various departments with their uniformed employes, scientific manufacturing methods, immaculate cleanliness and electrically-driven machinery used in this industry, the man of mechanical turn of mind will wonder where the power required for the driving of all this machinery, the heating of the water, the operation of the elevators, the lighting of the building and the cooling of the refrigerating room originates. To meet such diversified requirements as here exist, calls of course, for the installation of a modern and completely equipped plant, and this may be found in the basement of the building.

BOILER ROOM

HERE IS GENERATED all the steam used in the manufacturing processes, for the operation of generating and refrigerating units and their auxiliaries, and the heating of water used for domestic and manufacturing purposes.

FIG. 1. CORNER OF ENGINE ROOM SHOWING REFRIGERATING UNIT AND ONE OF THE GENERATING SETS

Installed in this boiler room are 6 250-hp. Babcock and Wilcox water-tube boilers operating under a pressure of 150 lb. gage and equipped with superheaters made by the same company superheating the steam 100 deg. F.

Water used for boiler-feed purposes is taken from city water mains, measured by a 4-in. Venturi recording and integrating meter and then passed through a Worthington feed water heater rated at 1500 hp. where it is

heated to a uniform temperature of 212 deg. F. with a back pressure on the steam supply of ½ lb. gage. A second but smaller heater is employed for heating the water used for domestic and manufacturing purposes the water for which is also taken from the city mains.

Number 2 buckwheat coal is the fuel used and is delivered to the plant in cars which are run into the boiler room placed on a 100-ton scale and weighed. It is then unloaded by means of a Hayward bucket having a capacity of 800 lb. and operated by a Yale and Towne electrically-driven hoist and carriage traveling on an elliptical overhead track. This track passes over the car to be unloaded and the coal storage space located in front of the boilers thus providing a ready means of unloading and depositing the fuel where desired or required. The motors of this equipment are of the direct-current type receiving their current from the exciter bus bars.

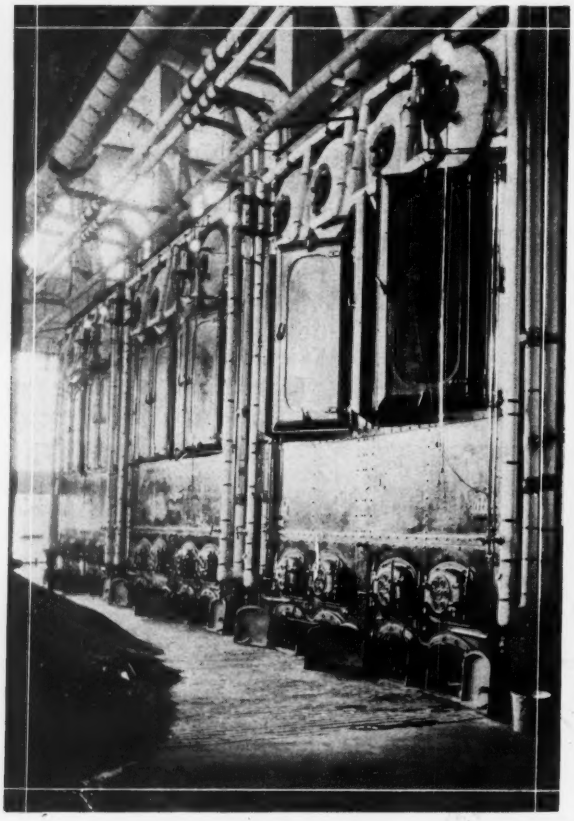


FIG. 2. BOILER FRONTS AND FIRING AISLE

As may be seen by referring to Fig. 2, no mechanical stokers are employed, the fuel being fired by hand into furnaces equipped with shaking grates.

Under normal operating conditions, sufficient draft is created by a large concrete stack placed at one end of the boiler room but entirely independent of the building. When load conditions, however, demand extra draft, this is produced by a No. 9 Sirocco blower driven by a 7 by 7-in. A B C steam engine, as illustrated in Fig. 3.

In this part of the plant, located directly back of the heater, is also a 1000-gal. Buffalo duplex steam pump used for fire service supplying 2 40,000-gal. tanks on the roof of the building and sprinkler system with water. Throughout all parts of the building the wet system is employed except in the refrigerating room where due to the low temperature being maintained, which would result in the freezing of the water in the pipes, the dry system has been installed.

Turbines and Refrigerating Machinery

In the engine or turbine room, a continuation of the boiler room and only separated therefrom by means of a party wall, are located the main generating units, the refrigerating machinery, exciters and switchboard. The machines supplying electric energy are 3 500-kv.a. General Electric Curtis horizontal turbo alternators delivering current at 225 v., 3 phase 60 cycles. The 225-v. service is used to supply the power lines, while for lighting a balancer set delivers current at a voltage of 110. Excitation for these units may be obtained from any one of 3 exciters, 2 of which are steam-turbine driven sets rated at 15 and 35 kw. respectively, while the other is a 14-kw. motor-generator set. All of these are of the General Electric make and deliver current at 125 v. While any of these machines may be used for exciting the alternator fields, the 14-kw. motor generator set is used for that purpose exclusively. The 15-kw. turbine-driven exciter is used only for starting and in

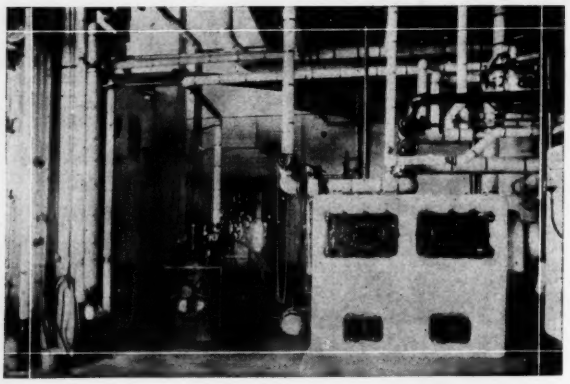


FIG. 3. FORCED DRAFT EQUIPMENT AND FEED WATER HEATER

emergencies, while the 35-kw. set is operated during shut-down periods such as during the night or over Sunday when but an insignificant amount of power is called for. When used for excitation purposes, all of these units are operated with a Tirrill voltage regulator.

Each turbine has its engineer's panel of black marble mounted on a nearby column with electric speed indicator, steam and vacuum gages.

After passing through the turbine bearings, the cooling water is discharged into a receiver located in the basement whence it is fed into the heater by means of a small duplex pump, thus retaining practically all of the contained heat.

At one side of the engine room, and about centrally located, is the main switchboard constructed of black slate generator, exciter and distribution panels with the necessary switching equipment and instruments mounted thereon. Iron grill work placed at each end of the board prevents any but authorized persons from entering the space between the wall and switchboard.

Figure 5 shows a general view of the switchboard while in Fig. 4 is illustrated the Venturi meter used for feed-water measurement, the main gage board and 2 of the smaller generating units used for exciter purposes.

On account of the perishable nature of the ingredients used in the manufacture of Sunshine products, it is necessary that a comparatively low temperature be maintained where they are stored. Likewise where the ingredients are mixed, the temperature must be kept at 50 deg. F. with a variation no greater than 2 deg. F. To furnish these low temperatures, a 75-ton Wolf Corliss engine-driven refrigerator machine is installed at the farther end of the engine room.

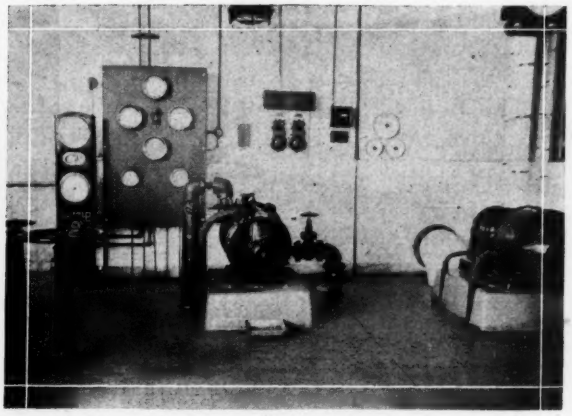


FIG. 4. GAGE BOARD, VENTURI METER AND TURBINE AND MOTOR DRIVEN EXCITERS

In the refrigerating room direct expansion is employed while in the mixing room brine is circulated by small motor- and steam-driven circulators located outside the engine room.

To facilitate the handling of heavy machinery a hand-operated crane running on girders placed between the 2 center rows of columns is installed. This crane may be used not only in the turbine room but also in the boiler room, as the tracks and girders upon which it rides extend through fire doors in the boiler room wall. By opening these doors, the crane may readily be moved from engine room to boiler room or vice-versa.

Below the engine room may be found the condensing and major portion of the pumping equipment, traps, receivers, oils, supplies and employes' lockers.

Westinghouse-Leblanc No. 5 condensers used in conjunction with the turbines are placed between the foundations of the various units. Along the same wall as the switchboard above are the pumps consisting of 2 12 by 7½ by 10-in. Worthington outside packed boiler feed pumps, 4 7½ by 8½ by 10-in. duplex house service pumps connected so as to be capable of delivering city, well or salt water and controlled by Ford regulators, and 2 10 by 14 by 18-in. Blake and Knowles duplex pumps used in connection with the heating system. Throughout the entire plant, Edgecombe metal packing is used on reciprocating pumps, also the condenser pumps.

LOAD

IN ADDITION to the interior lighting is a large roof sign which together with the general exterior and display lighting requires over 100 kw. of energy. The motor equipment about the bakery made up of machines ranging in size of from ½ to 40 hp. together with those of the 6 Otis traction elevators each of which has a

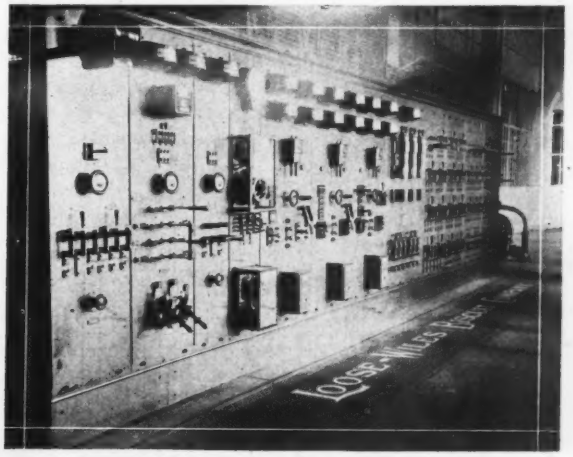


FIG. 5. MAIN SWITCHBOARD

capacity of 5000 lb. requires at full-rated capacity 2000 hp. A garage adjacent to the main building and used to house the company's electrical and gasoline contains 2 100-kw. General Electric motor-generator sets employed for charging purposes.

The entire electric and mechanical equipment of this institution was installed under the supervision of J. Shilcox, now chief operating engineer.

ELECTRICAL PROSPERITY WEEK is coming on and arrangements are progressing rapidly for a special pushing of electrical apparatus throughout the country. Different cities are planning to take up different lines of work, all bearing, however, on the question of greater use of electricity and electrical apparatus. In New York, the Supervisor of Playgrounds is planning to have an electric pageant, with school children taking part. In Brooklyn, the Illuminating Co. is planning a special campaign for house wiring contracts, co-operating with the electrical contractors to this end, and sending out literature to show the advantage and convenience to the house owner of having electric current for use in all domestic operations. The suggestions of the Westinghouse Electric & Mfg. Co. is, that in all cities large offices and public buildings be lighted electrically from top to bottom, from 7:30 to 9:30, with special outline designs wherever practical. In some of the high schools, special stress is being laid, in the classes in physics and electricity, on the features proposed by the Prosperity Week Committee.

In Syracuse, a Hall of Electricity will be established for the week, and very likely continued, where every known appliance which uses electricity for power will be exhibited and demonstrated, and daily lectures on the apparatus, and luncheons prepared by electricity.

Underground Heating

DATA ON DESIGN, CONSTRUCTION AND OPERATION OF SYSTEMS FOR HEATING FROM A CENTRAL PLANT. FROM ACTUAL PRACTICE BY MEMBERS OF THE NATIONAL DISTRICT HEATING ASSOCIATION

THESE data were collected by a committee of the Association consisting of Messrs. H. A. Woodworth, J. H. Walker and J. D. Hoffman, and are the result of broad research extending over practically a year of investigation. They apply equally well to the supply of heat from a central station to a community and to supplying a group of buildings from a single plant, and are for both hot water and steam systems.

In planning the drop in pressure to be allowed, it is deemed good practice to throw most of the friction on the trunk line and little on the laterals, the loss allowed in each lateral being determined by the circulating pressure where that lateral branches from the trunk.

Figure 1 is a series of curves showing pipe capacity for hot water radiation according to different allowance for drop in pressure due to friction. It involves radiation to be supplied, drop allowable and size of pipe, and any 2 of these being known the third can be read directly. The small cut at the upper right gives small values to a larger scale. The curves can also be used to determine the drop in the trunk line up to any given lateral, thus fixing the circulating pressure available.

FEEDING HIGH PRESSURE TO AN EXHAUST STEAM SYSTEM

IN MANY plants the exhaust steam is not sufficient to meet all needs, and some live steam must be supplied. It is desirable to avoid putting too great back pressure on the engines or turbines, and this can be done by feeding in the live steam at some point distant from the station, where a large demand exists. A live steam feeder can be run to such a point, and, as boiler pressure is to be carried by it, and it is in use for comparatively short periods, a large drop may be allowed, and a small pipe used.

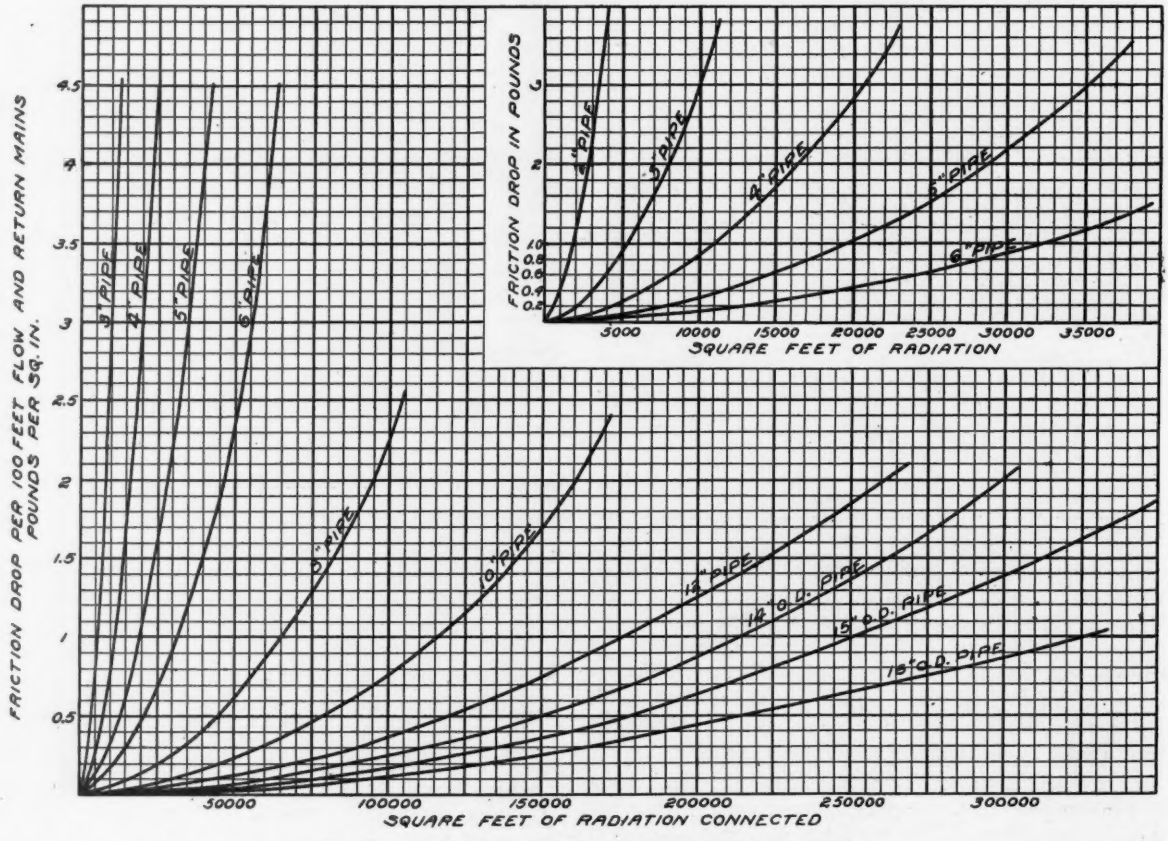


FIG. 1. FRICTION DROP IN HOT WATER HEATING MAINS

To determine the size of pipe or the pressure drop in a given pipe, Fig. 2 gives the solution of Unwin's formula. It has been checked for ordinary ranges of velocity, but should be used with caution where velocities are high.

As an example for 8-in. pipe carrying 40,000 lb. steam an hour with initial pressure 125 lb. absolute; on the horizontal 8-in. line find the 40,000 division and follow vertically up to the 125-lb. curved line. The equivalent velocity is practically 8000 ft. a minute, which multiplied by the factor for 8-in. pipe as given at the right of the pipe diagram, 0.8574 gives 6856 ft.

a minute as the actual velocity. The pressure drop per 100 ft. of pipe is found by following horizontally from the intersection on the 125-lb. curve to the right or left vertical scale to be 0.94 lb. per sq. in.

RADIATION CARED FOR BY STEAM SERVICE PIPE, SQ. FT.

Length Pipe	Nominal Size Pipe, In.						
Ft.	1½	2	2½	3	4	5	6
10	0 to 700	1600	2900	5900	12000	20000	35000
20	0 to 450	1300	2000	4000	8300	14000	24000
40	0 to 400	800	1500	2800	5500	11000	18000
60	0 to 250	550	1100	2000	4700	7500	13000
100		400	800	1600	3600	7000	10000
150		350	600	1300	2800	5000	9000

connections are best taken from the top of the main for all systems, the condensation in steam systems being cared for by drips and traps. The table is based on ⅓ lb. steam condensed per hour per square foot of radiation at a pressure of 2½ lb. in the radiator.

For hot water systems, no service pipe smaller than 1¼ in. should be used, and radiation can be connected satisfactorily on the following basis:

RADIATION CARED FOR BY HOT WATER SERVICE PIPE

1¼ in. service from 0 to 1000 sq. ft. rad.
1½ in. service from 1000 to 2000 sq. ft. rad.
2 in. service from 2000 to 4500 sq. ft. rad.
2½ in. service from 4500 to 6000 sq. ft. rad.

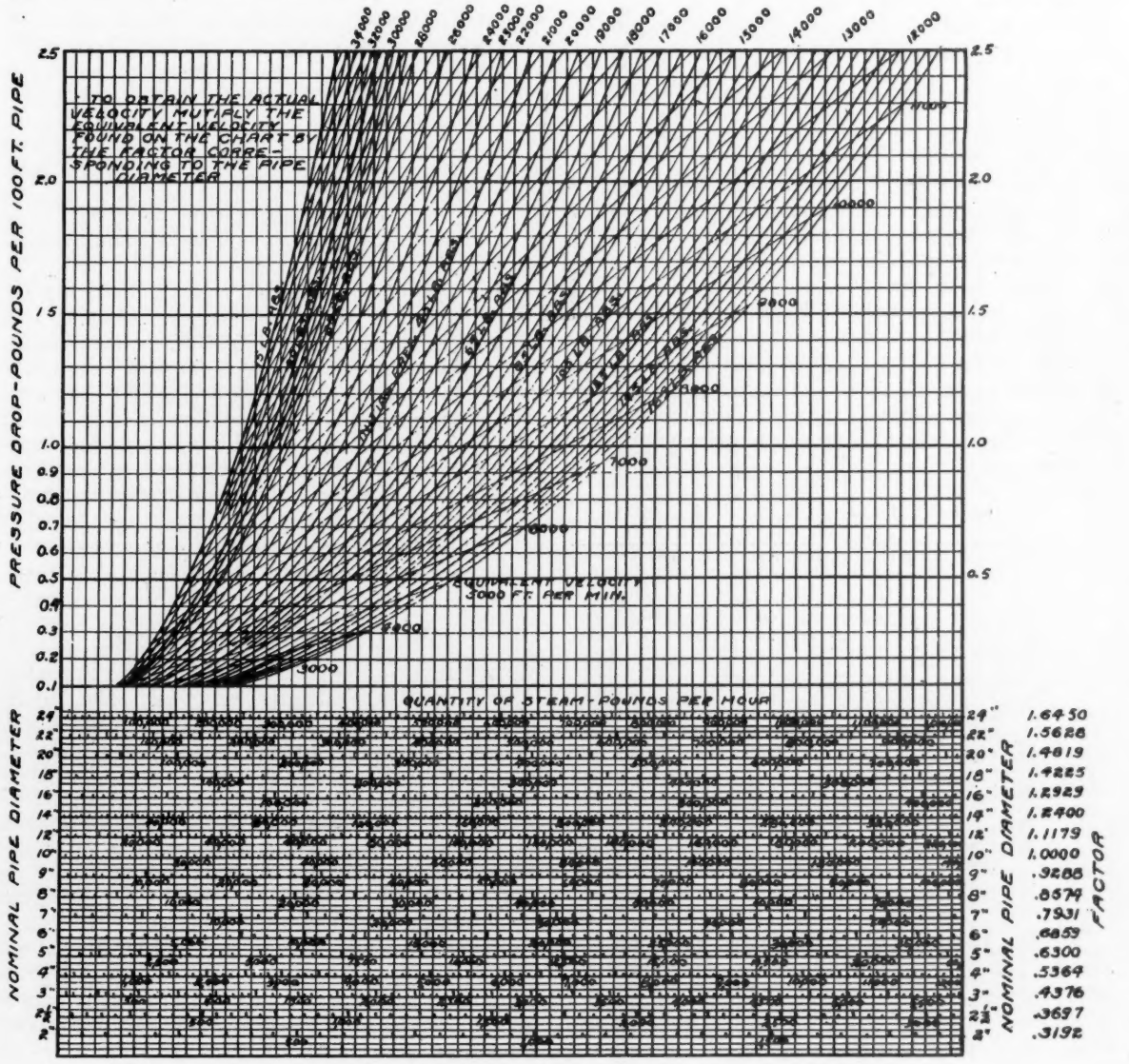


FIG. 2. GRAPHICAL SOLUTION OF PRESSURE DROP IN STEAM PIPES

Radiation Capacity

Radiation to be carried by steam pipe using exhaust steam is as given above, 2½-in. pipe being the smallest which should be used for underground mains. Service

Drain Traps

In draining condensation, traps of adequate capacity and adapted for the pressure should be used "where necessary." The location and frequency depend on the

layout and grading of the lines; low points should always be protected, but a trap every 2 blocks, with grading to carry condensation to it, ought to be sufficient. A screen to catch sediment should be provided either in the trap or ahead of it, and the trap should be of continuous bow type, discharging by gravity.

Pipe Installation

With careful attention to internal and external drainage, so that the insulation is kept dry at all times, the material for pipe lines seems to be of secondary importance, wrought iron, mild steel and cast iron being used successfully. Screwed or flanged joints may be used on the run, but flanged joints are needed at all fittings.

Tile underdraining appears necessary to long life, as instances are common of systems so protected in use for 25 to 30 yr. and in good condition, while installations without underdraining are being replaced in 7 to 10 yr. Crushed stone should be placed around the conduit, extending to the underdrainage, and the drainage tile should be connected to the sewer at all low points.

Welding of pipe is often found convenient and desirable. Four-inch and smaller is usually welded on the bank; larger sizes are suspended above the trench and welded, or are laid on timbers in the bottom and welded in place, the welding being done on top and pipe revolved as it is welded.

Costs will vary, but in common practice welding can be done at a cost 25 to 40 per cent less than screw couplings. For welding on the bank costs are about as given in the table. Welding in the trench will cost about twice as much.

COST OF WELDING PIPE ON BANK

Size Pipe	Labor at 30c per hour	Oxygen at 2c per cu. ft.	Acetylene at 2c per cu. ft.	Filling Wire at 12c per lb.	Total Cost
4 in.	15′ $0.075	8 ft. $0.16	7 ft. $0.14	0.5 lb. $0.06	$0.435
6 in.	20′ .10	10 ft. .20	9 ft. .18	0.75 lb. .09	0.57
8 in.	35′ .175	20 ft. .40	18 ft. .36	1.0 lb. .12	1.055
12 in.	50′ .25	30 ft. .60	27 ft. .54	1.5 lb. .18	1.57
16 in.	90′ .45	40 ft. .80	36 ft. .72	2.0 lb. .24	2.21

For welding 6-in. and 4-in. connections to 8-in. main, 90 deg.; cost of cutting $0.19, of welding $1.27, total $1.46.

For 4-in. connection on 8-in. main, 90 deg., total $1.095.

For 4-in. connection on 8-in. main, 60 deg., total $1.355.

Water and Steam Supply

Queries as to the water and steam which must be supplied per square foot of radiation to give satisfactory service brought widely varying replies. In steam the amount ran from 500 to 900 lb. per season, but the committee is of the opinion that 850 lb. per season of 8 mo. per sq. ft. effective radiation will be a reasonable estimate.

For hot water systems, it was found that the use of differential control valves to regulate the circulating pressure, and temperature control to regulate the flow resulted in marked economy. Many stations reported 6-8 lb. of water circulated per hour per square foot of radiation, while with the 2 controls satisfactory heating was accomplished with 3.5-4 lb. circulated. Tests showed that with proper control, more than 6 lb. circulated was needless, and that water pumped above this amount is all out of proportion to the increased heat derived. Uncontrolled circulation may run as high as 14 lb. per hour per square foot, with little benefit gained. Waste of heat on both water and steam systems will run from 20 to 100 per cent on uncontrolled systems.

Line Losses

On a system of mains, installed in wood lined tunnels, in use for 22 yr., concrete casing installed 10 yr. and wood casing installed 2 yr., average depth of tunnel being 18 ft, and of wood casing 9 ft., the average line loss per sq. ft. underground surface per hr. was 0.0583 lb. steam. A peculiar feature was that the line loss was greater in summer than in winter months, and the condensation for the year per sq. ft. of radiation per hour averaged 0.0944 lb. steam.

In another system with wood log insulation in use 6-12 yr. at an average depth of 6 ft. under street pavement, and some concrete conduit with 1 in. asbestos lining, in use 6 yr. the condensation per sq. ft. per hr. at 5 lb. pressure was 0.0511 lb. and at 25 lb. pressure 0.0588 lb.

In a system with concrete conduit, wood log and tunnel having 85 per cent magnesia insulation, lines in use 9 yr. at average depth of 6 ft. the condensation per hr. per sq. ft. ran from 0.014 lb. minimum in June to 0.068 lb. maximum in March, averaging 0.024 on one section for June, 0.047 on a second section; 0.047 lb. on the first section for March and 0.052 lb. on the second section.

Spite of all the line losses, many systems keep steam on the mains all summer, some to supply industrial needs, others to keep the lines dry, prevent corrosion of the pipe and preserve the insulation.

Value of Draft Gage

After a fireman becomes familiar with the indications of the draft gage connected to the furnace, he can learn a great deal about the condition of his fire by watching the draft gage. Thus, if the draft over the fire is low when the damper is full open, he may be sure that there are holes in the fire. If the draft is high, it is likely that dense clinker has accumulated on the grate. Thus a draft gage is not only a valuable instrument for adjusting the supply of air and the rate of combustion to the demand for steam, but it indicates the condition of the fire.

Some power plant owners may not be willing to provide draft gages for boilers, thinking that the draft-gage indications are too complicated and that the fireman will not learn to use them, or that the fireman can get along without draft gages because they got along somehow in the past without any. Neither of these reasons is good. Firemen have learned how to read the pressure gage and the water column and how to adjust the rate of feeding the water to the demand for steam. They will surely learn also how to adjust the air supply and the rate of combustion to the demand for steam.—The Isolated Plant.

2000-Kilowatt Mixed-Pressure Steam Turbine

UNUSUALLY LOW STEAM CONSUMPTION; CONSTANT SPEED MAINTAINED WITH HIGH, LOW OR MIXED PRESSURE SUPPLY; INTERESTING FEATURES OF CONSTRUCTION

IT IS not long since the standard speed of a 3-phase generator rated at 2000 kw., was 1500 r.p.m., while for one of 5000 kw. output the limiting speed was 750 r.p.m., a figure often adopted for 3000-kw. units. The progress since made is perhaps best exemplified by noting that 750 r.p.m. is the speed adopted for the 25,000-kw. units at Chicago, generating 25-cycle current. For 50-cycle turbo-generator units up to 25,000 kw., running at 1000 r.p.m., up to 15,000 kw. at a speed of 1500 r.p.m., and 5000 kw. at 3000 r.p.m., are in successful operation. These large impulse turbines have been designed in a single casing, single flow. The limit of size is, of course, the same whether the impulse or reaction principle be adopted, and is, in practice, fixed by the loading gage of railways, which will not admit of the transport of a wheel larger than some 13 ft. in diameter. The advantages of the higher speeds which have of recent years become practicable consist mainly in the greater output obtained for a given weight of plant. In fact, the volume of a turbine of a given type and given efficiency varies as $N\,d^2$ (R.P.M.)^2, where N denotes the number of pressure stages, and d the mean diameter of the bucket path. Hence by increasing the speed of rotation this volume can be reduced in the same proportion, and there is a corresponding reduction in weight.

The possible saving in weight would be in nearly direct proportion to the saving in volume were it not for the fact that this reduction in volume cannot be made merely by making the mean diameter vary in inverse ratio with the revolutions per minute. Were this possible, the centrifugal stresses would be the same whatever the speed of rotation and consequent bulk of the turbine. In actual fact, however, the mean diameter of the turbine at the exhaust end must be such that there is no excessive loss by the "carry over" of kinetic energy to the exhaust, and for a 28½-in. vacuum, the mean diameter in inches of the last row of blades of a high-pressure turbine is frequently about $0.75\sqrt{\text{output in kw.}}$, while for still higher vacua the coefficient may run up to unity. Hence the adoption of high speeds of rotation involves higher centrifugal stresses on the buckets and wheels, and methods of construction, fully satisfactory when centrifugal stresses were low, have now had to be greatly modified.

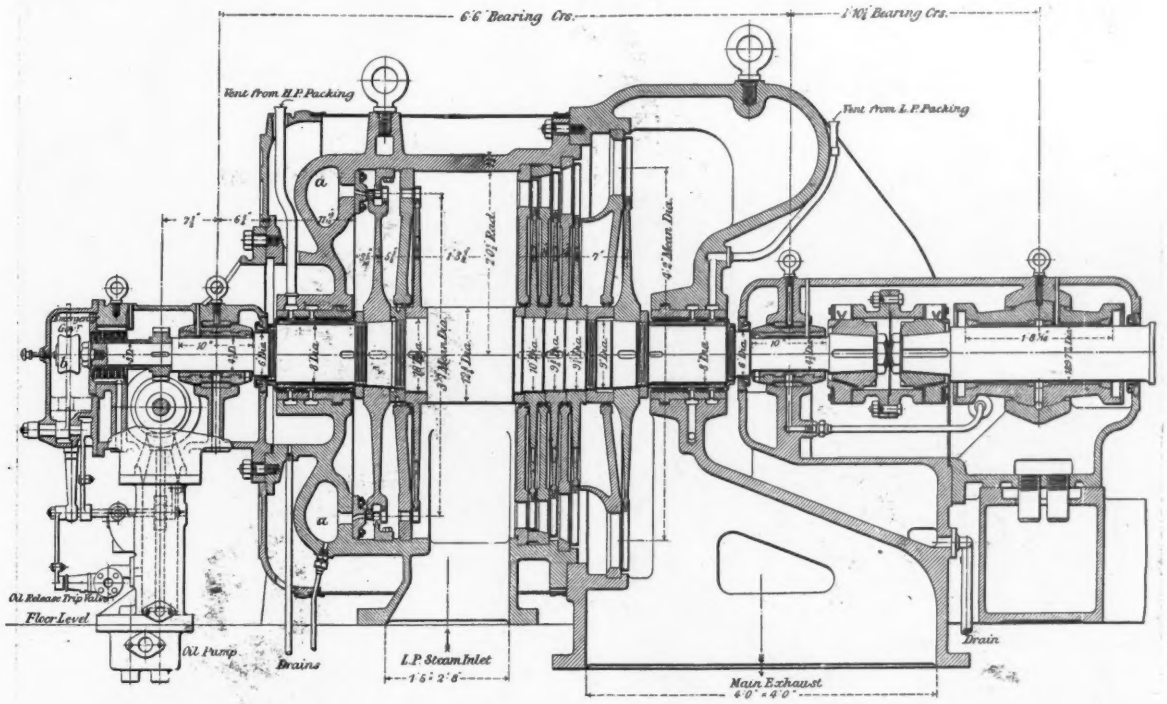


FIG. 1. LONGITUDINAL SECTION THROUGH 2000-KW. TURBINE

The general characteristics of the Rateau turbine as now built by Messrs. Fraser and Chalmers, Limited, is well shown by the accompanying illustrations which represent a mixed-pressure turbine designed to develop 2000 kw., the speed of rotation being 3000 r.p.m.

Of particular interest is the point that this turbine is giving a load of 2190 kw. with low-pressure steam alone, amounting to 71,000 lb. per hr., this output constituting at the time of construction a record for low-pressure steam in a single-flow turbine running at 3000

r.p.m. If the essential elements of the low-pressure part of this turbine were added to a high-pressure turbine designed for the same steam quantity—*i.e.*, 71,000 lb. per hr.—the output obtainable would be, with good steam conditions, more than 5000 kw., which well illustrates the progress made in steam-turbine design during the last few years.

A longitudinal section through the 2000-kw. turbine is represented in Fig. 1, which as stated, is of the mixed-pressure type, being designed to operate either with live steam supplied at a gage pressure of 150 lb. per sq. in. and at a superheat of 100 deg. F., or with low-pressure steam at about 15 lb. absolute derived from heat-accumulators, or with a combination of the 2. The guarantees given for the 2 first-named conditions were as follow:

In mixed-pressure working the following outputs were guaranteed under different conditions: Twenty-five per cent overload was to be obtained with 60,000 lb. of exhaust steam and 11,000 lb. of live steam per hour, or with 40,000 lb. of exhaust steam and 20,500 lb. of live steam, or with 30,000 lb. of exhaust steam and 25,700 lb. of live steam; the corresponding vacua being 28.25 in., 28.5 in., and 28.55 in. respectively. Full load was to be obtained with 60,000 lb. of exhaust steam and 400 lb. of live steam, or with 40,000 lb. of exhaust steam and 13,550 lb. of live steam, or with 30,000 lb. of exhaust steam and 19,000 lb. of live steam; the corresponding vacua being 28.5 in., 28.6 in., and 28.55 in. respectively. The normal hourly supply of exhaust steam available at the power-station is 60,000 lb. per hr., and the cooling-water supply on which the guarantees were based is 3800 gal. per hour at 60 deg. F.

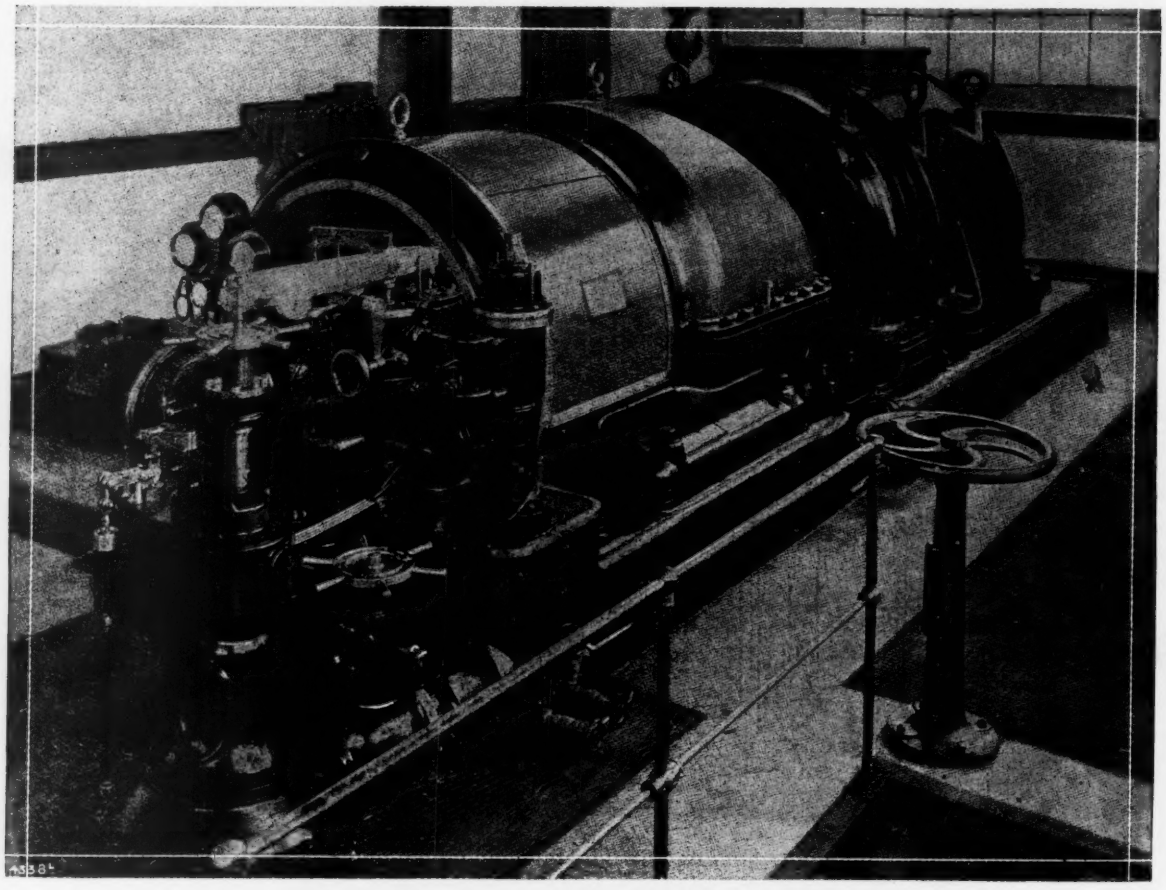


FIG. 2. 2000-KW. MIXED PRESSURE STEAM TURBINE

WITH HIGH-PRESSURE STEAM ONLY

—	25 per Cent Overload	Full Load	¾ Load	½ Load
Consumption per Hour.....lb.	38,400	31,350	25,300	18,800
Vacuum.....in.	28.7	28.75	28.75	28.75

WITH LOW-PRESSURE STEAM ONLY

—	9.5 per Cent Overload	Full Load	¾ Load	½ Load
Consumption per Hour.....lb.	71,000	60,500	49,300	38,100
Vacuum.....in.	28.25	28.5	28.65	28.7

It will be seen from Fig. 1 that the high-pressure section of the turbine comprises 2 stages only, the first of which is velocity-compounded, the wheel, which is 43 in. in mean diameter, having 2 rows of buckets. Although this wheel has a smaller mean diameter than the larger wheel at the exhaust end of the turbine, it carries a heavier rim-load, and is subject therefore to nearly the same centrifugal stresses. The design is such that these stresses are well below the elastic limit of the material used, which is mild steel.

Details of this wheel to a somewhat larger scale are represented in Figs. 5 and 6. The wheel fits on to a conical seat on the shaft, and is secured in place by a nut, as best seen in Fig. 1. Special interest attaches to the method by which the blades are secured. The blades are milled out of rectangular bars of nickel steel. As shown in Figs. 3 and 4, each blade terminates at its inner end in a fork, which straddles a seat turned for it on the wheel, and to which it is secured by rivets, as indicated. This system of fixing the blades is used throughout the turbine. Each blade is held by 2 rivets, each rivet holding the forks of adjoining blades. Each blade is thus held at 2 points, any shifting being rendered impossible, and yet the number of rivets is equal to the number of blades. For short blades (see Fig. 3), where the centrifugal pull on the fork is small, the forks are also short and the rivets arranged on one pitch circle. The blade is, owing to the shortness of the fork, very light, which is important for high-speed wheels with 2 or more rows of blades. For long blades the fork is made longer and the rivets arranged on 2 different pitch circles (see Fig 4); the sectional area of the fork on one of these pitch circles

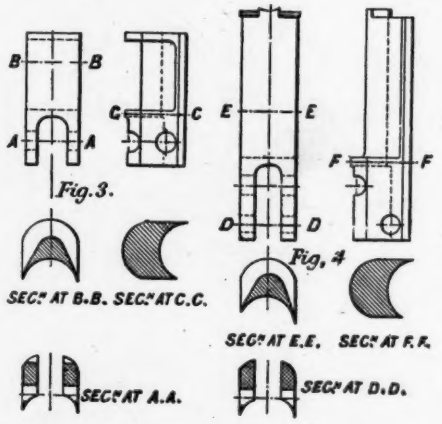


FIG. 3 AND 4. DETAILS OF IMPULSE BLADING

is reduced by one rivet only; the fork is thus capable of withstanding higher centrifugal pull and can be applied for longer blades. The particular advantage of these blades is that the sectional area of the fork where a rivet passes through can be made equal to or even larger than the sectional area of the blade proper, so that the stresses in the fork are not greater than in the blade instead of being much increased, as may happen when made with dovetail roots.

The low-pressure part of the turbine was designed for 71,000 lb. per hr. of low-pressure steam, supplied at 15 lb. per sq. in. absolute. With this steam quantity there is, in the interspace between the high-pressure and low-pressure part, about atmospheric pressure. With reduced steam quantity this pressure falls nearly proportionately.

When the turbine operates with high-pressure steam only, the steam quantity is considerably smaller; therefore the pressure in the interspace will be considerably below atmospheric. When working at full load, with high-pressure steam only, the pressure drop in the first stage is from about 150 lb. per sq. in. absolute to about atmospheric pressure; the second stage utilizes the pressure drop down to about half of the atmospheric pressure, the rest being utilized in the low-pressure part. If a supply of low-pressure steam be available, the high-pressure supply is automatically throttled by the action of the governor, as will be explained in detail later on. The last 4 stages form simply a Rateau exhaust-steam turbine. The most noteworthy point is that the wheel at the last stage is 50 in. in mean diameter, corresponding to a mean blade speed of 650 ft. per sec. Of these 4 wheels, all but the last rest on parallel seats on the shaft, and are tightened up one against the other by single nuts, as shown. The last wheel of the 4 is provided with a conical seat, on which it is held by an independent nut.

Casing

THE CASING of the turbine consists of 4 castings, combined in 2 to form upper and lower half casings, which are united at a horizontal joint. The exhaust

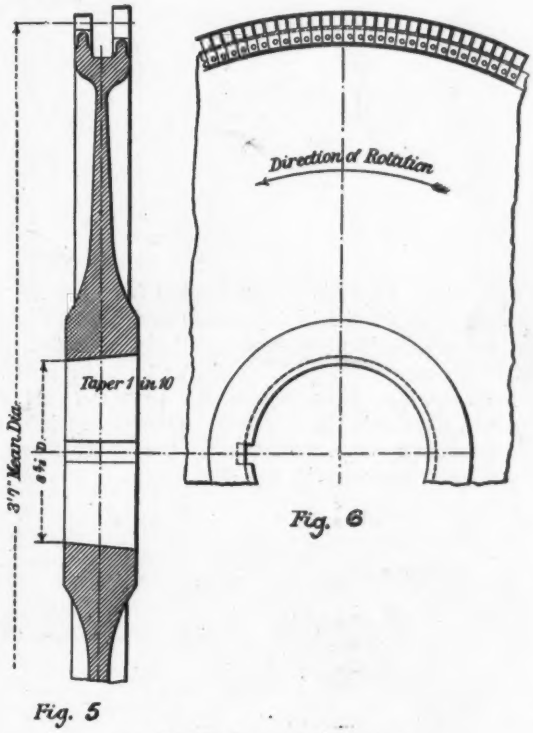


FIG. 5 AND 6. WHEEL DETAILS

end of the lower half is rigidly bolted to the bed-plate, provision for the expansion of the casing by heat being made at the high-pressure end. The diaphragms, Figs. 7 to 10, which divide the turbine into stages are also in halves, and are bolted together for machining; but these bolts are removed before they are put into place in the casing. The upper half of each diaphragm is bolted to the upper half of the casing, so that, on lifting the latter, the half diaphragms come away at the same time, leaving the rotor fully exposed. Leakage at the horizontal joint of the diaphragms is prevented by means of the feather shown in Fig. 7, which also shows how the guide-blading is continued past the joint. As will be seen, the curved portion of the blade is omitted from

one of the blades at the joint, merely the straight tail-end being retained. To check leakage between the shaft and diaphragms, baffles are fitted, as shown in Fig. 1, and to a larger scale in Figs. 8 and 9.

Where it passes through the turbine casing the shaft is packed by means of labyrinth glands. These are shown in place in Fig. 1. In the case of the gland at the low-pressure end of the turbine, steam at a pressure slightly above that of the atmosphere is admitted to a steam-belt near the center, its pressure being adjusted

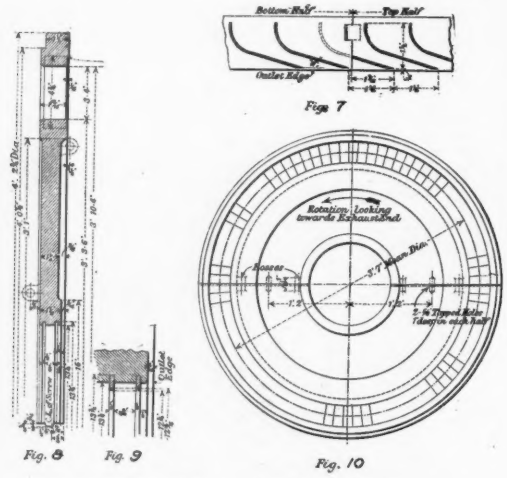


FIG. 7 TO 10. DIAPHRAGM DETAILS

so that a little vapor is always issuing from the leak-off pipe, shown. At the high-pressure end steam slightly above atmospheric pressure is similarly admitted to a belt in the gland at partial loads, as then the pressure in the casing is below atmospheric pressure. At full load and overloads the pressure in the casing is above atmospheric pressure, consequently the separate supply of sealing steam may be cut off.

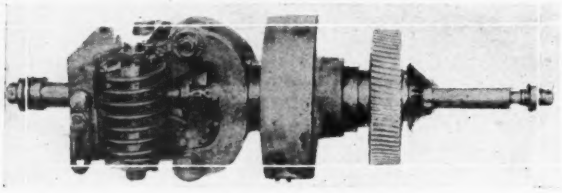


FIG. 12. GOVERNOR

As shown in Fig. 1, the bearings are not spherically seated, thus somewhat stiffening the shaft. In any case, however, the normal speed of the rotor is very much below the critical.

A small thrust, or rather alinement block is fitted at the high-pressure end of the shaft, as indicated in Fig. 1. The block is of cast iron lined with white metal, which is cast on to the previously tinned surface. Forced lubrication is provided throughout, and oil under pressure is also used for working the relays which operate the governor-valves. The oil-pump, which is of the gear type, is driven by a bevel-wheel on the end of the governor-spindle (see Figs. 1 and 11). As shown in the latter figure, the governor shaft is horizontal, and the helical gears driving it are so arranged that the governor can be withdrawn bodily, if required, for examination or repair.

A separate view of the governor is given in Fig. 12. As will be seen on reference to Fig. 11, it consists of 2 cast-iron blocks *h* pivoted to the arms *g*, *g* and pressed together by helical springs, as shown. A slotted link, bolted to one block, engages with a set screw on the other, and serves as a limit to the outward movement of blocks. Arms *i* keyed to each block engage with a collar on the shaft, which is accordingly moved up as the blocks move out. This motion of the collar, by means of appropriate link-work, operates the valve of the oil relay controlling the governor valves. The motion of the collar is resisted by the spring *j*, the pressure of which is adjustable by the hand wheel shown, so that the turbine can, when necessary, be speeded up 5 per cent above its normal rate of revolution. The governor spindle is attached to the collar and passes through the hollow governor shaft. This spindle rotates with the whole governor, and its longitudinal movement, corresponding to the out and inward movement of the gover-

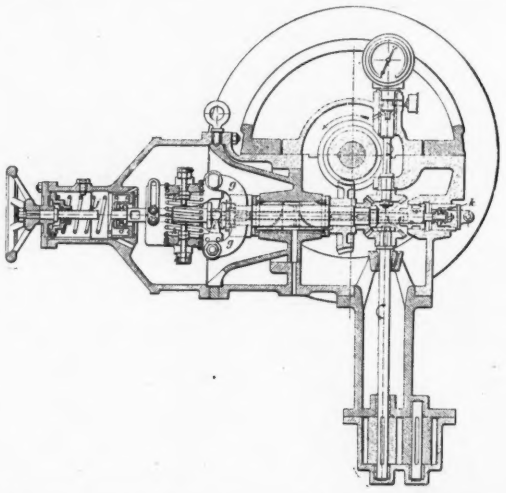


FIG. 11. GEAR TYPE OIL PUMP DRIVEN BY GOVERNOR SPINDLE

nor blocks, is transmitted by means of a double ball-bearing *k* to a sleeve connected to the oil-relay. The tachometer spindle is, as indicated in Fig. 4, driven in similar fashion, the oil-pump spindle being shown immediately below it.

The governor, main bearing, and thrust block are all carried in a bracket registered to the turbine casing, as indicated in Fig. 1.

As a guard against a runaway an emergency governor is also fitted. This is mounted at the high-pressure end of the main shaft of the turbine, as shown at *b*, Fig. 1. This trips the main stop-valve on the high-pressure supply when the speed of rotation exceeds the normal by 10 per cent, and simultaneously destroys the vacuum by opening a valve which allows air to enter the condenser.

The steam-supply valves and the relays operating them are illustrated in Figs. 13 to 15. The main stop valve for the high-pressure steam is shown at *n*, Fig. 15. It is a combined stop and emergency valve. The bush

in which the screwed valve spindle works, in opening or closing the valve by hand, is held in place by a catch, on release of which by the action of the emergency governor the valve automatically closes. For the low-pressure steam supply, on the other hand, it is the stop and ordinary governor valves which are combined into one at *m* (Fig. 13). This valve is closed by screwing down the hand-wheel, which forces it on to its seat. In starting up, the valve is released by unscrewing the hand-wheel, but this operation merely permits the valve to rise, and does not positively open it.

This is done by raising the fulcrum *k* of the floating lever *p q* by operating the hand-wheel Z. If there is steam. The floating lever *p q* in that case pivots about *p* as a fixed point, and the amount by which the high-pressure valve is opened depends upon the governor which controls the valve *u*, by which oil is admitted to or exhaust from the piston in the relay cylinder *v*. The spring above this piston always tends to keep both supply valves closed. A second floating lever *w*, Fig. 14, connects together the piston rod of the relay cylinder, the relay valve rod, and a link coupled up with the governor. As the speed rises the motion of the relay valve allows oil to escape from below the piston *v*, which accordingly moves down, thereby closing to a greater or lesser degree one or both of the steam supply valves.

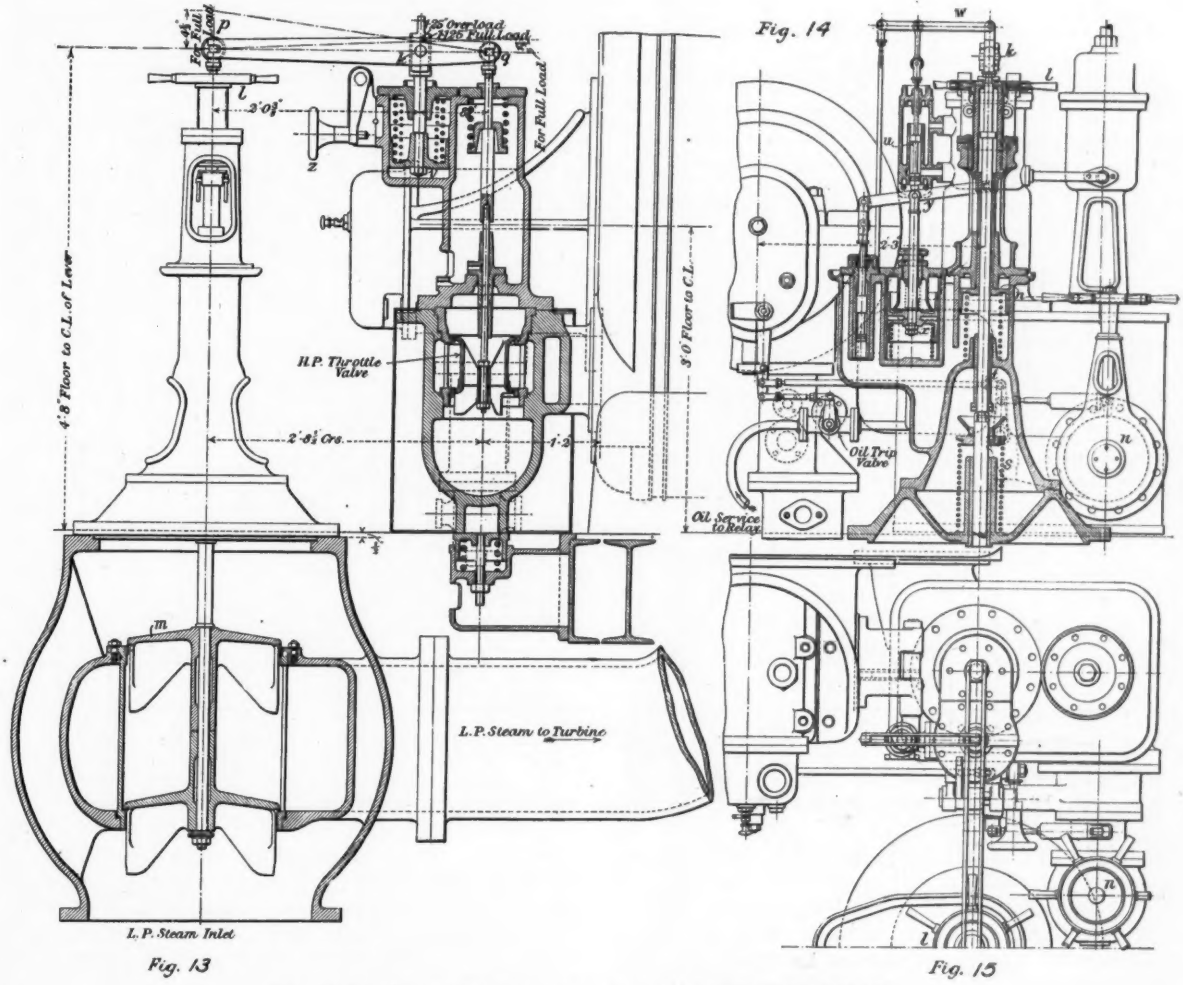


Fig. 13 Fig. 14 Fig. 15

FIG. 13 TO 15. STEAM SUPPLY VALVES AND OPERATING RELAYS

a supply of low-pressure steam available, this action causes the low-pressure valve to open; while if there is no such supply, the high-pressure valve is opened by the rising of the end *q* of the floating lever, the end *p* being prevented from moving by piston *n*, Fig. 14, which should be shown resting on top of the sleeve *t*. The rising of this piston is barred by oil pressure above it. So long as oil is prevented from escaping from the top of the piston *n* so long will the low-pressure valve remain closed, and the turbine run with high-pressure

If while the turbine is running on high-pressure steam a supply of low-pressure steam becomes available, the spring-loaded piston *x*, Fig. 14, is raised against the pressure of the spring above it, and by means of the floating lever *y*, actuates the relay valve shown, moving it into such a position that oil is allowed to escape from the above piston *n*. The low-pressure valve spindle then moves up accordingly, opening the low-pressure valve, and at the same time closing to a greater or lesser degree the high-pressure governor-valve.

It should be noted that whether the steam supply is high-pressure, low-pressure or "mixed," the speed remains constant. This is demonstrated in a remarkable manner by Fig. 2, reproduced from a photograph of the plant in actual operation. Here it will be seen that the floating lever connecting the high-pressure and low-pressure valve spindles has moved several times during the exposure. On the other hand, the cross-lever to the governor shown just above it has remained stationary, showing that the change-over has not affected the speed of the turbine. In fact, the amount of low-pressure steam supplied depends primarily on the pressure above the low-pressure valve, and the relay x always moves so as to maintain this nearly constant. Should the supply tend to fail, the pressure will fall. As a consequence, the piston x will move down, carrying with it the relay valve. The latter will accordingly admit oil above the piston n, which will move down in its turn, throttling the steam by more or less closing the low-pressure valve, while simultaneously the high-pressure valve is opened. As soon as the pressure in front of the low-pressure valve is restored, the relay valve is closed by the upward motion of the piston x.—Engineering.

IRRESOLUTION IS a worse vice than rashness. He that shoots best may sometimes miss the mark; but he that shoots not at all can never hit it. Irresolution loosens all the joints of a state; like an ague, it shakes not this nor that limb, but all the body is at once in a fit. The irresolute man is lifted from one place to another; so hatcheth nothing, but addles all his actions.—Feltham.

Increasing the Steam Pressure

METHOD OF CALCULATING THE SAVING IN STEAM. BY J. C. HAWKINS

IT is generally conceded that increasing the steam pressure will decrease the steam consumption required to carry a given load. The writer having read much on the subject recently had the opportunity of figuring the matter out. The engine was a 14 by 24-in. Corliss in good condition, and running at a speed of 108 r.p.m. The original pressure was 100 lb., but was increased to 140 lb. The indicator diagrams Nos. 1 and 2 were taken before and after increasing the pressure but with the same valve setting, and about the same load. These diagrams are alike except that the cutoff is earlier, and the terminal pressure is lower in No. 2 with the higher steam pressure than in No. 1. No. 1 diagram was taken with a 60-lb. spring, and No. 2 with a 70-lb. spring. The m.e.p. is practically the same in both cases. The piston rod was 2½ in. in diameter, and the clearance (assumed) 5 per cent. The average m.e.p. of the 2 ends of No. 1 card is 59.3 lb. and the horsepower is 117.6. The m.e.p. of the 2 ends of No. 2 diagram is 58.5 lb. and the horsepower is 116.

Increasing the pressure will have some effect on the losses in the cylinder. If the valves and piston are fairly tight, there will be little leakage, but it will be somewhat greater at the increased pressure. The steam at the higher pressure has a temperature 23 deg. greater which will increase to some extent the initial condensation and re-evaporation, although this will be partly

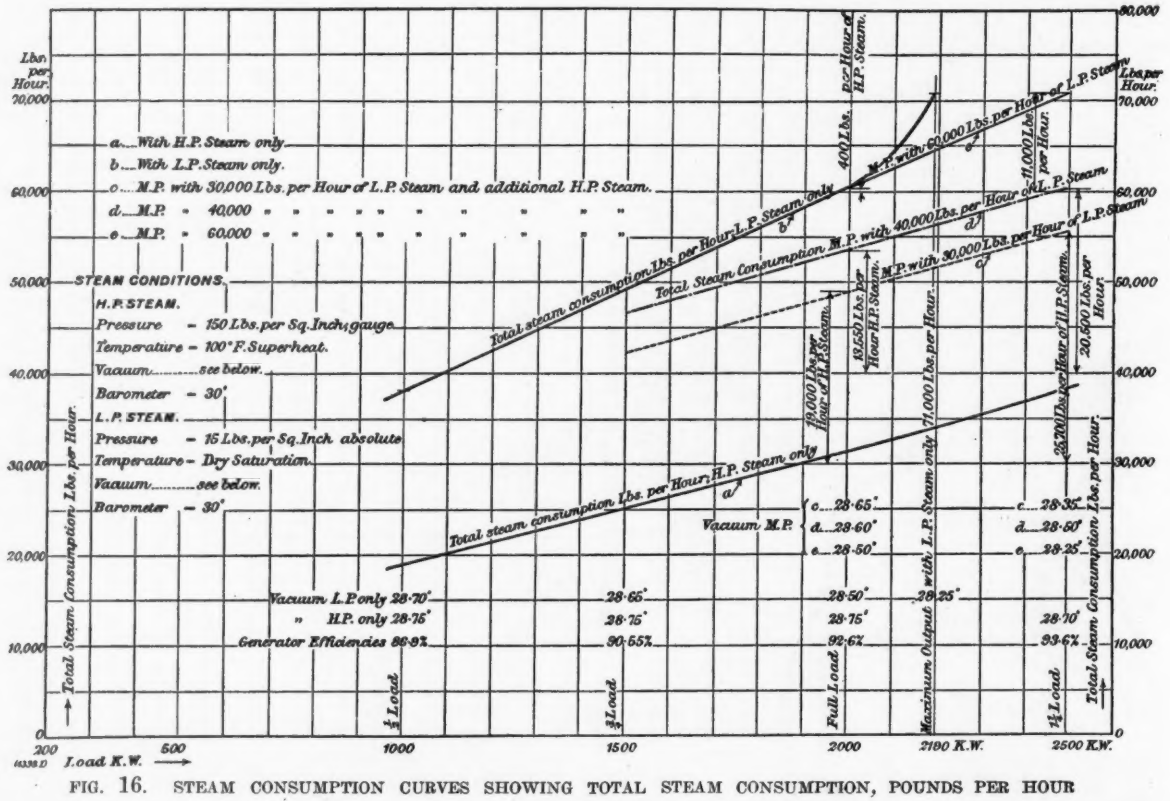
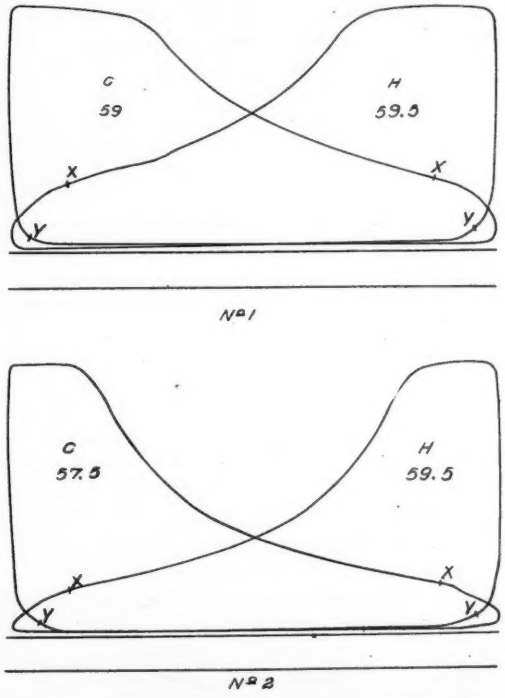


FIG. 16. STEAM CONSUMPTION CURVES SHOWING TOTAL STEAM CONSUMPTION, POUNDS PER HOUR

offset by the earlier cutoff which tends to increase this loss.

The usual method of calculating the approximate steam consumption per horsepower from the indicator diagram is as follows:

Locate a line on the indicator card perpendicular to the atmospheric line, and at a distance from the admission line equal to the per cent of length of the diagram that the clearance is of cylinder; then draw the vacuum line 14.7 lb. below the atmospheric line measured on the same scale as the spring with which the diagram was taken. Locate a point on the expansion line at some convenient point near the release, as at x, find the volume of the cylinder to this point including the clearance in cubic feet; multiply this volume by the weight of steam in pounds per cubic foot at the pressure in the cylinder at this point as measured by the scale getting the specific



CARDS TAKEN BEFORE AND AFTER RAISING STEAM PRESSURE

weight of steam from the steam table. This gives the gross amount of steam used per stroke. From this must be subtracted the steam saved by compression. This is found by locating a point on the compression line as at y and getting the volume to this point; then find the weight of steam in the cylinder at this point as before. Subtract this from the gross amount to get the net amount of steam used per stroke. Multiply by the number of strokes, and by 60 to get the pounds used per hour. This only gives the amount of steam represented by the volume of the cylinder, and makes no allowance for leakage or condensation.

Applying this rule to diagram No. 1, we have head end, volume to point x is 1.88 cu. ft. (one-half the area of the piston rod deducted from the area of the cylinder), absolute pressure at this point 44 lb.; weight of 1 cu. ft. of steam at 44 lb. pressure is 0.1062 lb. and $1.88 \times 0.1062 = 0.1996$ lb. per stroke gross. The cu. ft. up to point y is 0.217; absolute pressure is 22 lb. and the steam weight 0.0553 lb. per cu. ft. $0.217 \times 0.0553 = 0.0120$ lb. per stroke retained in compression; and $0.1996 - 0.012 = 0.1876$ lb. per stroke net on this end.

From the crank end diagram with x and y located for convenience at the same distance from the end, we have the same pressure and weight of steam at x, or 0.1996 lb. gross, less $0.0506 \times 0.217 = 0.011$; and $0.1996 - 0.011 = 0.1886$ lb. net on this end. $0.1886 + 0.1876 = 0.3762$ lb. per revolution net. $0.3762 \times 108 \times 60 = 2437$ lb. per hr. which, divided by 117.6 hp., is 20.7 lb. per hp.-hr., no loss being considered.

Diagram No. 2 figured in the same manner gives head end, 0.1502 lb. per stroke net, and the crank end gives 0.1535 lb. or 0.3037 lb. net per revolution. $0.3037 \times 108 \times 60 = 1968$ lb. per hr., which divided by the horsepower 116 gives 16.9 lb. per hp.-hr. This is the steam shown by the indicator and does not include that lost through initial condensation or leakage.

The condensation loss may be determined by the formula, $S = K \div \sqrt{P}$, in which S is the steam lost by condensation, P is piston speed in feet per second, K is a coefficient which for a single-cylinder Corliss engine in good condition at late cutoff and medium pressure is 21.96. Inserting the values for No. 1 diagram it becomes $S = 21.96 \div \sqrt{7.2} = 8.2$ lb. per hp.-hr. condensation.

The steam loss through leakage is found from the formula $S_1 = (35.14 \div \sqrt{\text{i.hp.} \times P}) + (3.62 \div P)$, in which S is the steam loss by leakage; 35.14 and 3.62 are constants; i.hp. is indicated horsepower; P is piston speed in feet per second.

Inserting the values for No. 1 diagram we have, $S_1 = (35.14 \div \sqrt{117.6 \times 7.2}) + (3.62 \div 7.2) = 1.71$ lb. per hp.-hr. lost by leakage, $20.7 + 8.2 + 1.71 = 30.6$ lb. total per hp.-hr. including all losses.

In diagram 2 applying the same formula for condensation, K is 19.83 or $S = 19.83 \div \sqrt{7.2} = 7.4$ lb. condensation loss, and the leakage will be $S_1 = (37.84 \div \sqrt{116 \times 7.2}) + (3.62 \div 7.2) = 1.81$ lb., or a total of $16.9 + 7.4 + 1.8 = 26.1$ lb. per hp.-hr. including losses.

This shows a net gain of 4.5 lb. per hp.-hr. for No. 2 over No. 1.

These figures are only approximate, and will vary with the condition of the engine, but for an engine of this type in good condition the total steam consumption seems to be as high as would be found in practice. The decrease in steam consumption of 4.5 lb. per hp.-hr. would be quite a saving at the end of a year.

There are, however, some other losses which might affect this saving, and would probably reduce it to some extent, and which would have to be taken into account in increasing the pressure, such as greater loss from radiation from the steam pipe, lower efficiency in the boilers due to less difference between the temperature of the steam and fire, extra cost of heavier piping and fittings, extra cost of boiler to carry the higher pressure unless these things had been provided at the start.

Cost of Setting for Horizontal Tubular Boilers

DETAILS OF COSTS FOR SPECIAL SAWDUST FURNACES. BY C. L. SAMSON

THESE 2 boilers and settings were especially designed for burning refuse from the dust collector of a woodworking plant. The furnaces were of the dutch oven type and the arches were higher above the grates than is usually found.

Some of the principal dimensions of these settings are as follows:

Diameter of shell.....84 in.
Length of shell.....18 ft.
Length of tubes.....16 ft.
Center of shell to bottom of ash pit.....12 ft. .01½ in.
Top of furnace to bottom of ash pit.....6 ft. 7 in.
Top of grates to bottom of ash pit in front.....2 ft. 4 in.
Top of grates to bottom of ash pit in rear.....2 ft.
Bottom of rear arch to floor of combustion chamber, 14 ft.
Dimensions of grates, ...6 ft. long by 7 ft. 2 in. wide
Height of front bridge wall.....3 ft. 8 in.
Height of rear bridge wall.....6 ft. 7 in.
Distance of dust pipes from front of furnace.....36 in.
Center to center of dust pipes.....42 in.

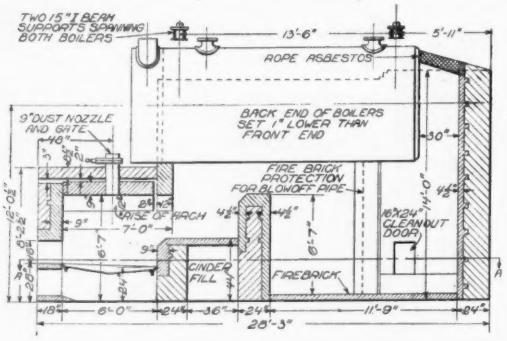

TWO 15" I BEAM SUPPORTS SPANNING BOTH BOILERS
ROPE ASBESTOS
BACK END OF BOILERS SET 1" LOWER THAN FRONT END
9" DUST NOZZLE AND GATE
FIRE BRICK PROTECTION FOR BLOWOFF PIPE
RAISE OF ARCH
CINDER FILL
FIREBRICK
18"x24" CLEANOUT DOOR
28'-3"

FIG. 1. SECTIONAL ELEVATION OF BOILER SETTING

The boiler shells were supported independently of the brickwork, 4 2-in. bolts on each boiler from 2 I-beam girders, each girder being made up of 2 15-in. I-beams, supported by 4 latticed channel girders made up of 9-in. channels. The girders spanned the 2 settings. The columns were laid up in the brickwork and the hollow between the channels was filled in solid with broken brick and mortar.

The vertical part of the blowoff pipes was protected by hollow triangular firebrick piers. The sides of these piers were ½ brick thick and 1½ brick long on each side. These piers extended from the bottom of the combustion chamber to 2 in. below the lower surface of the boiler shell. These last 2 in. were plugged with rope asbestos. The horizontal portions of the blowoff pipes were walled in with a hollow wall 1½ brick wide and with a single layer of headers laid loosely over the center of the wall to cover the pipe.

Side walls were stayed with 5 5-in. I-beam buck staves extending from the top to the bottom of the walls. These staves were bolted to the concrete foundation at the bottom and tied across both settings at the top with ⅞-in. threaded tie rods. There were no fore and aft tie rods, the cast-iron fronts being bolted to the dutch ovens with 24-in. bolts. A protest was made to the designer on this point, but he claimed that his work was the latest method in furnace design. Later developments indicated that the longitudinal ties should have been used for the dutch ovens pulled away from the boiler settings and the side walls of the settings cracked badly when the furnaces were fired up, although a slow wood fire was maintained for several days before the boilers were put in operation.

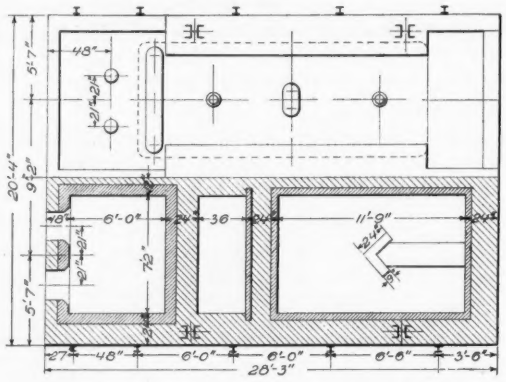


FIG. 2. HALF PLAN AND HALF SECTION AT A-A

Costs of setting the boilers and bricking them in on a foundation already in place were as follows:

Jacking up boilers to proper height—	
40 hr. at 25 cents per hour	$ 10.00
120 hr. at 16 cents per hour	19.20
	$ 29.20
Setting supports and anchoring boilers—	
15 hr. at 27½ cents per hour	$ 4.13
15 hr. at 25 cents per hour	3.75
	$ 7.88
Boiler brickwork—	
140 hr.—working foreman, at 75 cents	$105.00
505 hr.—brick layers, at 67½ cents	338.35
140 hr.—mixing mortar, at 16 cents	22.40
420 hr.—hod carriers and scaffold builders, at 16 cents	67.20
	$532.95

Costs of material for brickwork were as follows:

37,000 hard burned common brick, at $6.00	$ 222.00
20,000 firebrick, at $18.00 and $26.00	440.00
33 lb. lime, at 80 cents	26.40
22 yd. sand, at $1.60	37.20
60 bags cement, at 40 cents	24.00
50,000 lb. fireclay	38.00
	$ 787.60

Summary of costs—

Raising boilers	$ 29.20
Setting support	7.88
Brickwork	532.95
Material for brickwork	787.60
	$1357.63

The hod carriers, mortar mixer and scaffold builders were common laborers borrowed from the wood plant.

Electrical Machinery and Appliances

For Generating, Transmitting and Using Current

Some Properties of the Rotary Converter

VOLTAGE AND CURRENT RELATIONS; CONTROL OF DIRECT-CURRENT VOLTAGE; EXCITATION; RATINGS; OPERATION; AUXILIARY DEVICES. BY O. H. HENSCHEL

WITH the introduction and employment of high-tension alternating currents has come the extended use of the rotary converter for the transformation of these alternating currents to direct currents with an accompanying stepping down of voltage. Rotary converters find their greatest field of usefulness in substations, receiving energy from high-tension transmission lines and supplying low-voltage direct current for electric railway and lighting service, in the electrochemical and metallurgical industries, and are to some extent used to convert direct current to alternating current, in which case they are known as inverted converters. Inverted converters are generally found in industrial establishments where direct current is the only available source of energy and where some alternating-current apparatus, such as motors and lamps, is installed.

While to some extent possessing the characteristics of both alternating and direct-current machines, a rotary converter will, in many respects, be found to differ materially in its general makeup and mode of operation from its component parts.

In the actual motor and generator actions in the machine, the heating effect of the armature current and the magnetizing action of the armature current, the machine is essentially unlike a synchronous motor and essentially unlike a direct-current generator.

GENERAL THEORY OF CONVERTERS

AS AN ILLUSTRATION of the general workings of a rotary converter, let us consider an ordinary 4-pole direct-current generator having a ring-wound armature, commutator and brushes. If, then, such a machine is provided with 2 collector rings placed adjacent to the commutator or other convenient place on the shaft and each ring, as shown in Fig. 1, connected to the commutator at diametrically opposite points, connections for the 2 rings being at 90 deg. apart, it will be possible to drive this machine from some external source and take direct current from those brushes in contact with the commutator, and alternating current from those brushes in contact with the collector rings; it may also be driven as a direct-current motor and deliver mechanical power, or alternating current or both; or it may be driven as a synchronous alternating-current motor and deliver mechanical power, or direct current or both.

A machine like this, having 2 collector rings, is called a 2-ring or single-phase converter. A 4-pole, 3-ring or 3-phase converter is ordinarily provided with 3 collector rings connected to commutator bars 60 deg. apart, while the 4-ring or 2-phase converter, also of the 4-pole type, has 4 collector rings connected to commutator bars 45 deg. apart.

Letting the number of collector rings on a given converter, having a simple lap armature winding, be represented by the letter n, we find in an n ring converter that ring 1 is connected to all the commutator bars which for a given armature position lie midway between the north poles of the field magnet. Further, letting l be the number of bars between commutator bars of this set,

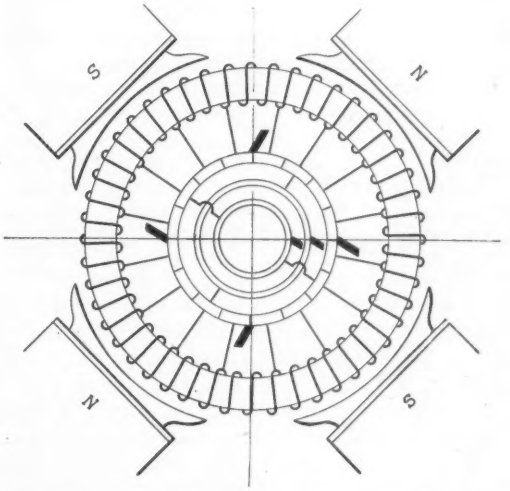


FIG. 1. DIAGRAM OF ARMATURE CONNECTIONS OF A 4-POLE, 2-RING ROTARY CONVERTER

ring 2 will be connected at points l/n bars ahead of the first set, ring 3, $2l/n$ bars ahead of the first set, ring 4, $3l/n$ ahead of the first set, etc.

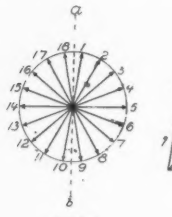
As an example, let us consider a 6-pole machine having 72 commutator bars to be made into a 3-ring converter. In this case, n or the number of collector rings is equal to 3. Ring 1 will then for a given position of the armature be connected to all commutator bars lying midway between the north poles of the field magnet, requiring 3 taps from the ring to the commutator and as these must be equidistantly placed, this ring will be connected to bars 1, 25 and 49. In this case, l is equal to 24, so that according to the above statement, it will

be necessary to connect ring 2 to those bars l/n ahead of the first set; i.e., ⅓ of 24, or 8 bars ahead, thus connecting ring 2 to bars 9, 33 and 57, and in a like manner ring 3 would be connected to bars 17, 41 and 65.

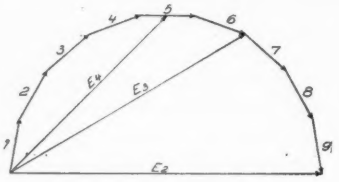
Voltage Relations

From the theory of alternating currents, we know that in the case of a true sine wave of alternating electromotive force, the value of the maximum electromotive force is $\sqrt{2}$ or 1.4 times that of the effective e.m.f.

Let E be the value of the steady electromotive force between the direct-current brushes of a 2-ring converter and E_2 the effective value of the alternating electromotive force between the collector rings of that machine. The maximum value of the alternating electromotive force between the collector rings of such a converter occurs at the instant the commutator bars to which the collector rings are connected come in contact with the direct-current brushes. This maximum value of the



F16.2



F16.3

FIG. 2. VECTOR DIAGRAM OF ELECTROMOTIVE FORCES INDUCED IN ARMATURE CONDUCTORS

FIG. 3. ELECTROMOTIVE FORCE DIAGRAM CONSTRUCTED BY MEANS OF VECTORS SHOWN IN FIG. 2

alternating-current electromotive force is then equal to E. Then from the above we can readily see that the effective value of the electromotive force between the collecting ring brushes is equal to the maximum electromotive force or E divided by $\sqrt{2}$, or $E/1.4$.

The relation existing between the electromotive forces for not only a 2-ring but any n-ring converter may conveniently be shown graphically.

Assume, in Fig. 2, that each of the various radii or vectors represent those electromotive forces induced in the respective conductors of a rotary converter armature as it revolves. While the value of the induced electromotive force in any conductor is the same as that in any adjacent conductor, it is, however, ahead or behind in phase that electromotive force in the adjoining conductor by an amount equal to $360/N$, where N is the number of conductors. In the case of an armature having 18 conductors, the electromotive force vectors of which are shown in Fig. 2, we find the various conductors spaced at distances of 360/18, or 20 deg., so that the electromotive forces induced in the various adjacent conductors are out of phase by that amount.

The value of the electromotive force across the brushes of a 2-pole, 2-ring converter, the rings of which are connected to opposite commutator bars, is equal to the vector sum of the electromotive forces induced in the conductors lying between these taps, or the sum of the electromotive forces induced in those conductors distributed throughout an angle of 180 deg. With a little study, the method of constructing the diagram in Fig. 3 will be readily understood. Consider those vectors only which lie on the right of dividing line ab, and which are numbered 1 to 9, inclusive. Transferring them as shown, employing the same lengths and relative directions as in Fig. 2, we obtain the polygon having sides, 1, 2, 3, 4, 5, 6, 7, 8, 9 and E_2. We therefore find that the value of the electromotive force between the rings of a 2-ring converter is equal to the chord E_2 of Fig. 3, subtending an angle of 180 deg.

In a similar manner, the value of the electromotive force across any 2 rings of a 3-ring converter, the rings of which are connected to the armature windings at points 120 electrical degrees apart, is represented by E_3, that chord of the polygon subtending an angle of 120 deg., and the effective electromotive force between any 2 rings connected to the armature windings at points 90 electrical degrees apart may be represented by that chord E_4 of the polygon which subtends an angle of 90 deg.

Further investigation of this phase of the subject is needless, as the theoretical ratios of alternating to direct-current voltage are not always found to hold good in practice. This is due to various causes, chief among which are the deviation of the generator voltage from a true sine wave, the voltage drop in the armature windings, the position of the direct-current brushes on the commutator and the degree of field excitation.

FIG. 4. ACTUAL ROTARY CONVERTER VOLTAGE RELATIONS AS FOUND BY TEST

Type of Converter	Actual ratio of voltage across rings to voltage across direct-current brushes	
	No Load	Full Load
2-Ring	0.715	0.725
3-Ring	0.610	0.620

When the alternating electromotive force of supply is approximately harmonic, when the pole faces of the converter cover ¾ of the armature surface, and when the direct-current brushes are in a neutral position, the voltage ratios are approximately as in the table of Fig. 4. This table does, however, not include the voltage ratio values of the 4 and 6-ring machines, because the alternating voltage of a 4-ring converter is usually specified as the effective voltage between opposite rings, which is the same as that of a 2-ring machine. The alternating voltage of a 6-ring converter is usually specified either as the voltage between opposite rings, in which case it is the same as that of a 2-ring converter or the voltage between every other ring, in which case it is the same as that of a 3-ring converter.

Control of Direct-Current Voltage

In any given converter a practically fixed ratio exists between the alternating electromotive force and the direct-current electromotive force, so that unless means are provided to produce the contrary, the direct-current electromotive force will rise and fall with the applied alternating electromotive force. In order, therefore, to vary the voltage of the direct-current side of a converter, it is necessary to vary the alternating-current voltage supplied to the collector rings. This control of direct-current voltage may be obtained by

means of several methods such as, (a) variable ratio transformers, (b) induction regulators, (c) synchronous regulators or boosters, (d) direct-current boosters, or (e) compounding.

Variable Ratio Transformers

For this method of voltage variation, ordinary potential transformers are interposed between the supply lines and the machine. The secondaries of these transformers are provided with taps connected to a special switch or controller, so that by using different taps, the voltage between collector rings may be varied to suit the direct-current side requirements.

Induction Regulators

These used in connection with rotary converters are similar to the regulators employed to raise or lower the voltage of single-phase light and power circuits, and consist of a primary winding of comparatively fine wire connected across the line wires and a secondary winding in series with the load. By varying the relative positions of these 2 windings, a voltage "boost" or "buck" is readily obtained.

Synchronous Boosters

One of the most widely employed methods of rotary converter voltage control is the use of synchronous regulators or boosters. These are merely small alternating-current generators having the same number of field poles as the converter, and generally direct connected to the converter and driven by it. The revolving armature of the booster is connected in series with the armature and collector rings of the converter, and the field magnets are separately excited.

As the intensity of the booster field is increased, the voltage induced in the armature windings is correspondingly increased and added to the line voltage, thus raising not only the voltage supplied to the converter armature, but also that across the direct-current brushes. In some machines found in practice, the excitation and polarity of the booster may be reversed, so that the booster voltage may be subtracted from the normal value of the impressed alternating voltage and a corresponding reduction of direct-current voltage obtained. This method then gives the same results, although to a somewhat greater extent, as the induction regulator.

Direct Current Booster

No attempt is made to control either the voltage supplied the collector rings or that delivered across the direct-current brushes, in this scheme of voltage control. A low-voltage direct-current generator or booster is connected in series with the direct-current line and by varying the voltage generated by this booster, which is added to that delivered by the converter, the line voltage may be varied to meet requirements.

Compounding

If, under normal conditions, a converter is excited so as to give an electromotive force less than that of the supply lines, the machine will, when running at a speed corresponding with the frequency of the system, draw a lagging current which tends to strengthen the converter field so that the generated electromotive force of the alternating side is made equal to that of the system. In a similar manner, if the field be over-excited, the current taken from the supply lines will be leading and will tend to demagnetize the fields sufficiently to make the alternating electromotive force again equal to that of the system.

Connecting inductive reactances in the supply lines will, with a lagging current, cause a voltage drop and with a leading current a voltage rise, so that, by under-exciting the converter field the voltage applied to the collector rings will be less than that of the supply lines, while an over-excited field will draw a leading current resulting in a voltage across the collector rings higher than that of the line. The change in phase between the electromotive force and the current delivered to the converter is due to the degree of excitation which is, in turn, regulated by the load current; the greater this is, the greater will be the excitation which, in turn, will draw a greater leading line current, resulting in a higher applied electromotive force. With the inductive reactance, the effect of the series coils on the field of a rotary converter is not unlike that produced by compounding a direct current generator.

In many instances, it is found that the inductance possessed by the transmission lines and converter circuits—that is, the series windings—is sufficient to produce the desired result so that no additional inductance is necessary.

Regulating Pole Converter

This type of machine is claimed by its manufacturers to offer the simplest method of obtaining a variable direct-current voltage from a constant alternating-current voltage and differs from a standard machine only in that the pole structure is divided into 2 or more parts—a main pole and regulating poles. With constant impressed alternating electromotive force the direct-current voltage is changed by varying the excitation of the regulating poles, the only auxiliary apparatus required being a field rheostat for varying the regulating-field current.

Field Excitation

Rotary converter fields may be excited by armature reaction, by direct current taken from the commutator of the machine or by use of an auxiliary direct-current generator. Of these methods, the last 2 named are most generally employed in practice.

Armature Reaction Excitation

This method is used to but a limited extent. When a synchronous motor or rotary converter draws a lagging line current, the magnetizing action of this current in the motor armature strengthens the field magnetism of the machine to such an extent that no outside source of excitation is required.

Self Excitation

This method is similar to that used in the ordinary direct-current generator, and is brought about by the employment of series, shunt or compound windings. When employing only the series windings zero excitation accompanies zero load, while full-rated excitation is obtained with full-load direct-current output, a scheme not well suited for rotary converter work.

The shunt scheme gives an approximately constant field excitation and is extensively used. By inserting an adjustable rheostat in series with the shunt winding, the excitation may be varied for the purpose of controlling the power factor of the converter.

Compound excitation provides for slightly increased field excitation with increased direct-current output. Its use is limited, however, for the reason that too great an increase of field excitation results in the converter falling out of synchronism and stopping.

Separate Excitation

With this scheme, separate direct-current exciters are used which may either be direct-connected to the converter or separately driven by a motor, engine or turbine.

(To be continued.)

Unique Substation Practice

Transformers and Switching Apparatus Mounted on Wagons Allow Ready Transfer from Place to Place. By A. P. Connor

SUBSTATIONS are mainly employed where they can be permanently utilized, or where there is a brief but important need for electric energy. In the first case, the equipment is installed within a masonry structure and is designed to stand years of service. In the second case, the substation consists of a portable arrangement used on electric railways carrying heavy loads on portions of the lines during certain seasons, and

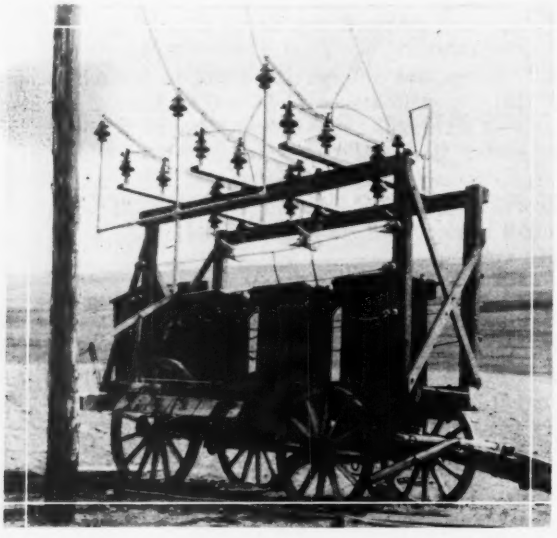


FIG. 1. PORTABLE SUBSTATION MADE UP OF 3 75-KV.A. TRANSFORMERS; VOLTAGE STEPPED DOWN FROM 16,500 TO 2200 V.

the use of such a temporary station in the shape of transformer equipment placed on a car and carrying the temporary additional load prevents heavy expense for feeders, not economically used during the greater part of the year.

The present case hardly comes within the bounds of the above, but rather intermediately between. This condition is better understood after a reference to the circumstances is made.

The substations referred to herein were necessitated in a somewhat peculiar manner. The Government has a project to take care of in the matter of irrigating the lands about the Sun River in the neighborhood of Great Falls., Mont., and desired to have electricity, as well as other facilities for the settlers who would arrive with the completion of the project, as well as for those already there. At the same time, it had in mind the desirability of providing means for power facilities necessary for the construction of the features of the project. This latter was an important item, owing to the difficulties encountered in procuring fuel for power purposes, as well as obtaining contractors to take up the construction work at a reasonable cost. A contract was

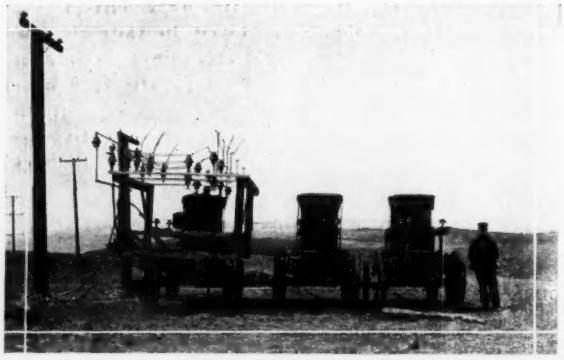


FIG. 2. PORTABLE SUBSTATION WITH SEPARATE SWITCH AND TRANSFORMER WAGONS

therefore entered into with the Great Falls Power Co. of Montana for a certain amount of power at one cent per kilowatt-hour under certain conditions, by means of which the construction of over 100 miles of transmission line by the power company was provided for. This line was arranged for the delivery of electricity at 48,600 v., 3 phase, 60 cycles, and is composed of 3 strands of No. 8 wire on 45-ft. poles spaced 300 ft. apart. The line is grounded at each pole with a ¼-in. steel stranded wire.

The Government then arranged to take current off this transmission line wherever it was needed, and arranged its construction contract, on the basis of the contractors using the electricity, which, as well as the main transformers, it agreed to furnish.

To meet its needs more specifically, the Government ran a transmission line of its own toward and along the construction sites of the project. This line consisted of No. 6 wire supported by 30-ft. wooden poles spaced from 150 to 450 ft. apart. This was connected to the power company's line through transformers and operated under a tension of 16,500 v. Figure 3 shows the transformer station at which this connection was made.

Every part of this equipment is arranged for easy and convenient movement. While the transformers are provided with wheels running on tracks, the stationary parts of the equipment not so important to move are more or less permanently fixed. This particular station has a capacity of 1750 kv.a. One set of transformers lower the main line voltage to 16,500 v. and another set steps this latter voltage down to 2500 v., which is used directly on the construction work. The Government

line running from this point to feed the non-local construction apparatus, works at a potential of 16,500 v.

Lack of apparent protection to the transformers is somewhat startling at first, although on consideration there will be found but little need for such, and in reality may be said to be better without it.

A fence was put around the station in case some stranger crossing the desert should not see or realize the danger of such apparatus, or in case he should be of the kind anxious to see, for experience's sake, a 48,500-v. transformer's working parts at close quarters. It may be here added, that the project involves the construction of miles of canal, water tunnels and a 140-ft. dam. The Government transmission line follows 2 of these canals for 45 mi., and during the construction sub-stations were connected to the line and the construction apparatus fed therefrom.

In Fig. 1 is shown one of the smaller sub-stations,

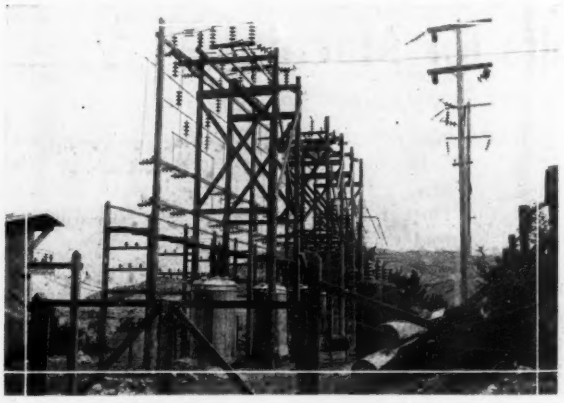


FIG. 3. A 1750-KV.A. OUTDOOR SUBSTATION; TRANSFORMERS TAKE POWER AT 48,600 V.

which consists of a wagon carrying the transformers, the switches, choke coils, lightning arresters and other equipment. It is connected to the transmission line by taps, and the feeder from the transformers for the construction apparatus consists of an armored cable having 3 conductors and run on the ground to the apparatus. This cable is under a tension of 2200 v.

In Fig. 2 is shown another, but larger, substation consisting of transformer wagons and a switch wagon, the transformers being rated at 75 kv.a. each. The feeder cable from the station is seen plainly in the illustration.

As the work progresses, these substations are moved to suit it, or rather the apparatus working on them. The stations are open and provide an efficient and effective means for doing their part of the duty imposed. They avoid the expense of any building or covering, and while they may be indefinitely located in any place, they are always adapted for ready movement to another location. The whole arrangement is one of simplicity, accessibility and inexpensiveness.

THE NATIONAL GAS ENGINE ASSOCIATION announces the change of its bulletin from a weekly to a monthly publication, also that data sheets on the use of gas and gasoline engines and driven machinery are now in preparation, and will be issued as fast as prepared.

Installing an Elevator Motor

BY RECEIVER

AN engineer put in a motor to run an elevator, and connected it to the line in the proper way, as shown in Fig. 1. Chasing out the connections, it is seen that the shunt, or fine winding coils, are of the shunt fields and are connected at one end to the line through the terminal A on the terminal board, the connection of which runs direct from one side of the circuit breaker, or fuses, while the other shunt field end is connected to the motor terminal B, and hence to the

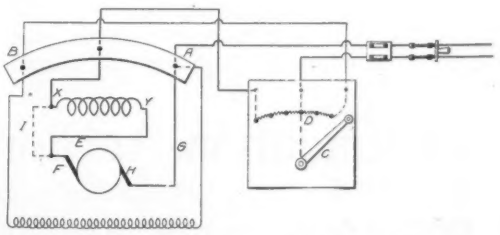


FIG. 1. ELECTRICAL DIAGRAM OF ELEVATOR MOTOR AND STARTING RHEOSTAT

other side of the line. The result is that when the rheostat handle C is moved on to the first contact D, current flows through the shunt field, thus magnetizing it and creating a strong field for the armature current to act upon, giving a good starting torque. When the current from the armature passes through the series fields, this reinforces the shunt field, provided the polarity of the 2 is the same, and thus holds up the field strength as the load comes on the motor.

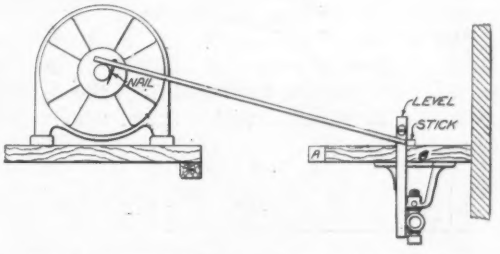


FIG. 2. METHOD OF LINING UP MOTOR SHAFT

The motor under consideration turned in the wrong direction, so it was reversed. As the best way to reverse the direction of armature rotation is to change the direction of the current through the armature, while the field current remains unchanged, that was done like this:

The line lead E was disconnected from the brush F, also the lead G from H. E was connected to H and G to F. The armature then ran as desired. It remained now to ascertain whether the shunt and series fields were of the same polarity, and were assisting or opposing one another. To determine this, the engineer disconnected the shunt field connection at B, on the motor, and

put an arrow with chalk on the pulley to show which direction the motor ran. The motor then started as a series motor, and the direction of rotation was not that desired. The shunt field was connected, and the series fields were short-circuited, as shown at I, which enabled the motor to run as a simple shunt, and the direction of rotation was correct. Therefore, the connections X Y of the series field were interchanged, Y being connected to the terminal board and X to the brush, the motor again started when the direction of turning was correct, and the fields assisting one another.

The scheme adopted was to belt the motor to a countershaft, thus enabling the motor and counter to run at all times, and belt from the shaft to the elevator machine. A heavy balance wheel was mounted on the shaft, to assist in speed regulation.

Due to the location of the rafter timber, as shown in Fig. 2, it was impossible to line the motor and shaft in the usual manner, so the lining was accomplished like this:

A light stick was run parallel to the shaft and rested loosely on the stringers B. This stick was moved until a level held as shown, one end touching the shaft, and the other the stick, showed it to be plumb. The end of the stick was then secured and the same operations repeated for the other end. This made the stick in line with the shaft and above it as noted.

A light wood stick about 6 in. longer than the distance from the shaft to center of the armature shaft was cut and a nail driven into one end such a distance from the end that when one end rested solidly and square on the stick, the nail just felt the armature shaft. The motor was moved until the same distance was obtained at each end, when the motor was rigidly secured to its supporting stringers and belted up, and has given entire satisfaction since.

Foundation Anchor Bolts for Machinery---V.

INSERTED AND COTTER BOLTS. BY TERRELL CROFT

CEMENTED-IN bolts, Fig. 1, are used where anchor bolts must be set in existing masonry. To place such a bolt, a round hole about 3 times the diameter of the bolt that is to go into it, is drilled in the proper position in the masonry. Then a bolt is inserted centrally in the hole and a grout of lead, sulphur or cement is poured around it. Such a bolt, placed in a cement grout should probably be imbedded to a depth equal to at least 25 and preferably 30 diameters.

RELATIVE EFFECTIVENESS OF SULPHUR, LEAD AND CEMENT

EXPERIMENTS were conducted as follows:* Fourteen holes were drilled in a ledge of solid limestone; 7 were 1⅜ in. in diameter, and 7 were 1⅝ in. in diameter. All holes were 3½ ft. deep. Fourteen bolts, plain at the lower end, and having a nut at the upper end, were cemented in the holes as indicated in the following table; all of the bolts were ragged for 3½ ft. at their lower ends. All were permitted to stand until the cement was 2 weeks old, then pulled with a lever, with results as below:

Bolt Set in	¾-In. Bolts in 1⅜-In. Holes.	1-In. Bolts in 1⅝-In. Holes
Sulphur		
1	Developed full strength, 16,000 lb.	
2	Developed full strength, 16,000 lb.	
3		Pulled out under 12,000 lb.
4		Developed full strength, 31,000 lb.
Lead		
1	Developed full strength, 16,000 lb.	
2	Developed full strength, 16,000 lb.	
3		Pulled out under 13,000 lb.
4		Developed full strength, 31,000 lb.
Neat Cement		
1	Broke without pulling out.	
2	Broke without pulling out.	
3	Broke without pulling out.	
4		Broke without pulling out.
5		Broke without pulling out.
6		Commenced to yield at 26,000 lb., but sustained load a few seconds and then broke.

*American Architect, page 105, Vol. XXIV.

While these experiments do not indicate the adhesive strengths of the materials in pounds per sq. in., they show conclusively that cement is the best of the three. It is the most reliable and strongest and therefore should be used where possible.

It is not necessary that a cemented-in anchor bolt have a head on it as has the one in Fig. 1. The head greatly increases its resistance to pulling out, but if the bolt be inserted 30 diameters into the cement, more than the full safe strength of the bolt will be developed.

Anchor bolt holes are sometimes drilled after the machine is in position on the foundation. In some of the mining plants in the West, it is the practice to build

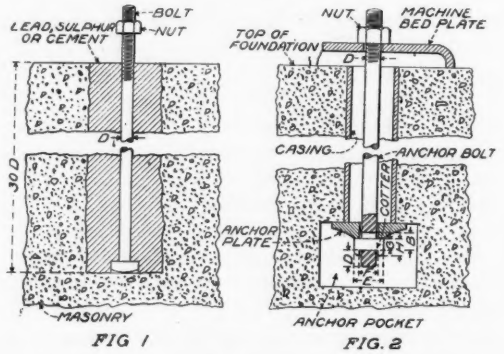


FIG. 1. MACHINE BOLT CEMENTED IN FOUNDATION
FIG. 2. COTTER ANCHOR BOLT WITH COTTER IN POSITION IN FOUNDATION

foundations for machines without any anchor bolts in them, or provisions therefor. Then when a machine is received it is mounted on the foundation, the holes for the bolts are drilled with an air drill, the machine bedplate being used for a template. The holes having been drilled, the bolts are inserted and grouted in with Portland cement mortar. It is claimed that, where power drills are available, this is an economical and satisfactory method of anchoring a machine.

For plain rods that are imbedded in concrete the threading at the imbedded end does not appreciably increase the resistance to withdrawal. It appears that the cavities in the threads of a bolt fill with air, preventing the concrete or cement from filling the cavities; in fact, it seems altogether possible that slightly deforming a bolt may decrease its resistance to withdrawal rather than increase it, unless the bolt can be materially deformed as has been explained in previous articles. Roughening its surface slightly does not appear to increase its holding power appreciably. Cutting "jags" or gashes in the lower end of a bolt, or pounding some depressions in it with a hammer, have apparently little effect one way or the other.

Cotter Bolts

Cotter anchor bolts are sometimes used, particularly where bolts of large diameters are involved. With such bolts it is sometimes cheaper to cut a slot for a cotter in the end of a rod as shown in Fig. 2 and to make the cotter, than it is to thread the rod and to provide a nut for it. Figure 2 shows a cotter anchor bolt complete in position in a foundation with its anchor plate and cotter in place. The proportions of a line of cotter anchor bolts and cotters that have given satisfactory service in practice are shown in Table I.

TABLE I. DIMENSIONS OF COTTER ANCHOR BOLTS AND COTTERS

D	BOLT		COTTER				
DIA. OF BOLT	C WIDTH OF SLOT	B LENGTH OF SLOT	E LENGTH OF COTTER	F LENGTH OF NICHE	G EFFECTIVE WIDTH	H OVERALL WIDTH	*T THICKNESS OF COTTER
½	⅛	¾	1½	9/16	⅜	11/16	⅛
⅝	3/16	1	1⅞	11/16	⅜	13/16	3/16
¾	3/16	1⅛	2¼	11/16	1	1 1/16	3/16
⅞	¼	1¼	2⅜	13/16	1⅛	1 3/16	¼
1	¼	1⅜	3	1 1/16	1¼	1 7/16	¼
1⅛	5/16	1⅜	3⅜	1¼	1⅜	1½	5/16
1¼	5/16	1⅜	3¾	1⅜	1⅜	1¾	5/16
1⅜	⅜	2	4½	1½	1⅜	1⅞	⅜
1½	⅜	2⅛	4½	1⅝	1⅞	2	⅜
1⅝	7/16	2¼	4⅞	1⅞	2	2⅛	7/16
1¾	7/16	2½	5¼	1⅞	2¼	2⅜	7/16
1⅞	½	2⅝	5⅝	2	2⅜	2½	½
2	½	2¾	6	2⅛	2½	2⅝	½
2¼	9/16	3⅛	6¾	2⅜	2⅝	3	9/16
2½	⅝	3⅜	7½	2⅝	3⅛	3¼	⅝
2¾	11/16	3¾	8¼	2⅞	3½	3⅝	11/16
3	¾	4	9	3⅛	3¾	3⅞	¾
3¼	13/16	4¼	9¾	3⅜	4	4⅛	13/16
3½	⅞	4⅜	10½	3⅝	4⅜	4½	⅞
3¾	15/16	5	11¼	3⅞	4¾	4⅞	15/16
4	1	5⅜	12	4⅛	5	5¼	1
4¼	1 1/16	5¾	12¾	4⅜	5⅜	5⅝	1 1/16
4½	1⅛	6	13½	4⅝	5⅝	5⅞	1⅛
4¾	1 3/16	6⅜	14¼	4⅞	6	6¼	3/16
5	1¼	6⅝	15	5⅛	6¼	6½	1¼
5¼	1 5/16	7	15¾	5⅜	6⅝	6⅞	1 5/16
5½	1⅜	7⅛	16½	5⅝	6⅞	7⅛	1⅜
5¾	1 7/16	7⅝	17¼	5⅞	7¼	7½	1 7/16
6	1½	7⅞	18	6⅛	7½	7¾	1½

ALL DIMENSIONS IN INCHES

* THE COTTER MUST ACTUALLY BE A TRIFLE THINNER THAN THE DIMENSIONS SHOWN IN THIS COLUMN SO THAT IT WILL FIT INTO SLOT C

As to strength, the cottered ends of bolts (not having upset ends), proportioned as indicated in Table I, up to 2 in. in diameter will have a tensile strength practically equal to that of the bolt itself. For diameters larger than 2 in., cottered ends will have strengths from 10 to 20 per cent less than those of the bolts. If the strength of the cottered end must be equal to that of the bolt, the end must be upset accordingly. The reason that the cottered ends of the small diameter bolts have practically the same tensile strengths as the bolts themselves is because the amount of metal removed from the cotter slot is in these cases just about equivalent to that removed in cutting threads at the top end of the bolt.

Cotter anchor bolts of square rod can be made as shown in Fig. 3. Anchor bolts of this type have been used extensively in steel mills where only rods of square section are rolled. A cotter like that shown in Fig. 3 is used in the lower end of the bolt to bear against the anchor plate and thereby prevent it from withdrawing from the foundation. The original square section of the rod is retained for the major portion of the bolt at its lower end, but a part of the upper end of the rod is forged to a round section so that it will pass through the circle holes in the machine bedplate and so that it can be threaded.

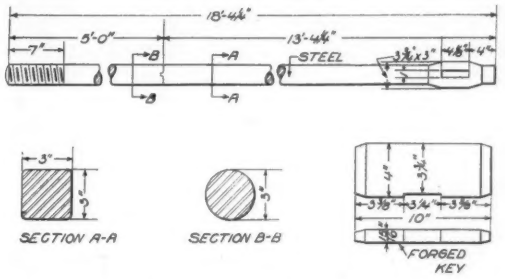


FIG. 3. FOUNDATION BOLT OF SQUARE ROD AND FORM OF KEY USED

The People's Ice & Cold Storage Co. has just been organized in Colon by a number of Americans for erecting and operating an ice plant, with 30 tons daily capacity. The company has been incorporated under the laws of the Republic of Panama, and is capitalized at $60,000, United States currency.

An up-to-date method of making ice will be employed. A Diesel or crude-oil engine will furnish the power. The water will be drawn from the city mains, and will be filtered to remove impurities. During freezing the water will be agitated with washed air to produce clearness.

The people of Colon are now charged $18 a ton for ice by the one local refrigerating concern, which uses the steam method. The new company proposes to supply ice to local consumers at $6 a ton. As the company also expects to supply ice to ships in transit through the canal, by permission of the Panama Canal authorities, the prospects of a profitable business seem to be favorable.

The ground for the plant has already been leased and bids for construction work and for machinery and other equipment are being prepared. The entire charge of the plant during construction and operation will be in the hands of a practical engineer of many years' experience in ice making.

(The name of the engineer and manager, to whom all correspondence relating to equipment and supplies should be addressed, may be had from the Bureau of Foreign and Domestic Commerce, Washington, D. C.; refer to file 65,394.)—Commerce Reports.

Wet and Dry Compression*

COOLING THE GAS. BY A. G. SOLOMON

THE gas leaving any ammonia compressor must have its temperature lowered to the temperature corresponding to its pressure at saturation before any liquefying begins. Part of the condenser coils must be used to take away this superheat. With the dry gas compressor, it is best to have the gas enter the condenser at the third pipe from the bottom, in that way using 3 lengths of pipe for precooling the gas. The cooling water is then not unnecessarily heated as it would be if the gas entered the top pipe and the coldest water also comes in contact with the hot top pipe first.

Some condensers have 2 or 3 lengths of pipe of each stand submerged in the condenser pan purposely to take care of this superheat. This is good in some ways, but it has one bad feature in that the water stays warm and is not efficient for use on the steam condenser. The submerged pipes also accumulate hard scale much more quickly than if not submerged. All such little details count in a year's time toward the successful and economical operation of an ice plant.

Another objection to the very high temperature of the discharge of the dry gas compressor is the effect it has on the oil which is used for lubrication. The oil is heated and atomized, and passes into the discharge almost in the form of a gas. The oil separator cannot stop this and it continues on to the condenser and is deposited on the inner pipe surface where it acts as insulation. In time, this oil becomes loosened and passes through the liquid line and so into the evaporating coils of the ice tank. There it remains until steamed out during the next winter's overhauling. This oil is often troublesome at the regulating valves, causing blocking of the very small openings which are used for fine regulation.

In the operation of a dry gas compressor, it is often noticed that more carelessness is found in regard to the charge of ammonia than when the wet gas machine is used. The discharge is always hot and the suction free of frost and if the charge becomes low, the operator often drags along without putting in the necessary ammonia which is required to get good results. On the other hand, when the wet gas compressor is used, he will notice a shortage of ammonia much more quickly. The rod will give trouble and the frost on the suction valves will melt, and to a great many engineers, this is the first and perhaps only indication that more ammonia is needed. It is a sure sign of shortage, but it appears rather late for the good of the ice business.

When the wet gas machine is used in an ice plant, the fore cooler is not arranged to use the return vapor from the ice tank for cooling. The fore cooler is supplied with a coil which is fed by a separate regulating valve; this allows for better regulation of the temperature of the distilled water. This same arrangement is, of course, also found in plants using the dry gas compressors; but, as a rule, the suction method of fore cooling is used.

For large cold storage plants and packing houses, the wet gas machine is mostly used; this is necessary for the reason that it is almost impossible to adjust the great number of regulating valves close enough to keep liquid from coming back to the machine. In some large installations of this kind, the volumetric efficiency of the compressors is extremely low owing to the amount of liquid handled and the resulting re-expansion.

Accumulators or liquid traps and liquid ammonia pumps are used in such places to keep this heavy liquid out of the compressors. This liquid can be pumped through a separate stand of ammonia condenser, which really acts as a receiver, and then fed to some evaporating coils in the regular way. There are some plants where the liquid collected in this way is handling coils and by so doing giving a great saving in its pumping and cooling.

At a certain point in the amount of liquid injected into the compressor for cooling purposes, the greatest volumetric efficiency is obtained. It is almost impossible to state just what this amount must be under the varying conditions of operation. To make this subject more clear, it is easily seen that the more ammonia admitted directly into the cylinder, by injection, the less vapor will be drawn from the evaporating coils. This is very true if we consider only amount and cylinder area; but we must also realize that the temperature of the cylinder walls, heads, valves and piston has a great deal to do with the amount of vapor actually pumped.

If the cylinder is hot and no liquid injection is used, the saturated vapor will expand on entering the cylinder and in that way help to fill the cylinder without drawing the full volume from the evaporator. The hotter the cylinder, the less vapor will be taken in, as the pressure caused by the heat will keep ammonia from entering through the suction valve. With liquid injection, this cylinder heat is given up directly to the ammonia and, therefore, a larger amount of vapor will pass in through the suction valve.

Another source of loss in the wet gas machine is through the liquid connection which is provided on a great many of the stuffing-boxes. The liquid connection is made into the bottom of the stuffing-box and by this means, ammonia can be expanded into the oil lantern to cool a hot rod. The top opening of the stuffing-box is connected into the suction close to the compressor. Carelessness in the handling of this liquid will send ammonia directly from the liquid receiver, through the oil lantern and into the compressor. Many engineers disconnect this liquid cooling line, and I do not blame them; also, a large number have had such poor success with the direct liquid injection that it has been discontinued. All cylinder cooling must then be accomplished by the liquid contained in the saturated vapor from the evaporating coils.

*Continued from page 837 Sept. 1 issue.

FOR DRIVING 1300 piles with a 6½-hp. gasoline engine, operating a drop hammer weighing 1650 lb., the Engineering Record gives a cost of 18.2 cents per lineal foot of pile in place, including the cost of the pile, 7.5 cents per lineal foot. Itemized costs are, for the piles delivered, $1438.80; for labor, $1653.93; engine and hoisting outfit, $340; scow, $154.45. The piles were driven, from the scow which had the engine mounted on it, to an average depth of 13.15 ft.

LETTERS DIRECT FROM THE PLANT

Cash Paid For Ideas Accepted. Sketches Desirable.
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Blowoff Pipes and Valves

THE FOLLOWING description of blowoff pipes and valves in the plant of which I have charge, is presented for the purpose of describing the practical results secured in actual service. Little theory is included, as that might be taken as a matter of opinion on the subject.

Figure 1 shows the arrangement of pipes and valves at the rear of one boiler (forming part of a battery) that is fitted with a patent setting consisting partly of 2-in., extra-heavy pipes located on the sides of the furnace, of a tubular boiler, and thence continued through the rear wall of the setting. This accounts for the 3 lines of blowoff pipes discharging into one main line near the floor. The original blowoff valves

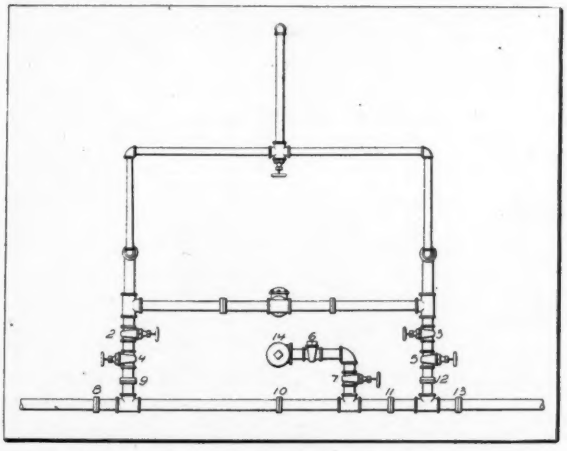


FIG. 1. AN UNUSUAL SYSTEM OF BLOWOFF PIPING

are shown at 2 and 3. In design they are ordinary gate valves, but are fitted with nickel seats. For 20 yr., these valves were perfectly tight. After that, they began to leak slightly, hence other valves were added at 4 and 5. These are also gate valves, but not of the low-pressure type. They are not extra heavy, but of special type between the 2 kinds just mentioned. All nipples and pipes are extra heavy. All threads are of standard length, and every joint was "made up" with special care under my personal supervision. These threaded joints were lubricated with graphite, ground fine and mixed with cylinder oil. No other pipe joint compound was used, yet every one is tight.

The asbestos packed plug cock, 6, was not perfectly tight, but did not leak excessively. Gate valve 7, however, was put on to make the line absolutely tight. It will be noted that these gate valves are all in vertical pipes, the reason for which is as follows: If a gate valve is located in a horizontal pipe, with the stem in either a horizontal or a vertical position, pieces of scale will lodge in the pocket formed by the seats on either side of the center. When the gate is moved so as to close the valve, these pieces of scale are trapped in the pocket, from which they cannot escape. They prevent the gate from descending as far as it ought to, hence the valve leaks until there is a chance to remove the bonnet and clean the pocket. By this time, the leak may be made permanent by the friction of water rushing through the nearly closed passage, and the valve is spoiled. When a gate valve is located in a vertical pipe, the pieces of scale are nearly always carried through the valve, as they cannot lodge in the pocket; hence, when the gate is forced into place, the valve does not leak.

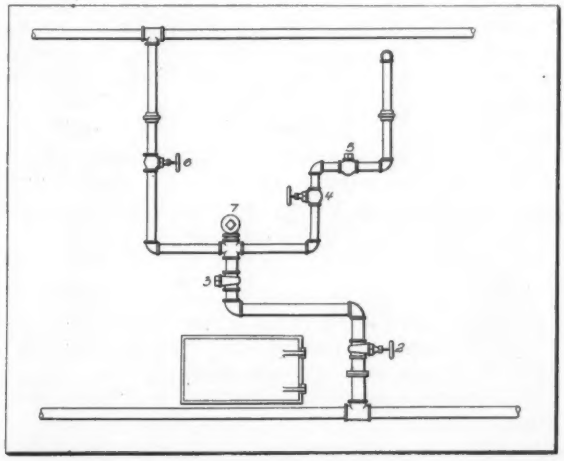


FIG. 2. A FLEXIBLE SYSTEM OF BLOWOFF PIPING

These boilers are blown down every day (with few exceptions) and the blowoff valves are operated as follows: Number 4 is opened wide, then the wheel is turned back about ½ revolution to prevent the stem from being held fast by expansion when the valve is heated; No. 2 is then opened wide and closed without delay, when 4 is closed. Numbers 3 and 5 are operated in the same way. Then 7 is opened wide, followed by the opening of 6 to full capacity. It is then partially closed until the water level is lowered to the desired point, when it is fully closed, and 7 shut. By this method, the lower valve in each case is always wide open when water is passing through it; hence the gate is protected from the wearing action of this water which contains more or less foreign matter that certainly does not tend to lubricate valves or fittings as it passes through them.

An undesirable result secured in practice from this system of piping is that all of the extra-heavy wrought-iron pipe located below the valves, 4, 5 and 7, corrodes rapidly, hence it has been renewed several times.

In order to facilitate the removal of corroded nipples and pipe, I installed flange couplings for this purpose. For illustration, by taking 4 bolts out of each coupling at 8, 9 and 10, the section of piping between them can be quickly removed, the corroded piece taken out, a new one substituted, and the whole replaced in a short time. Another section is shown between 11, 12 and 13, which can be treated in the same way if necessary. Others which are not illustrated can be treated in like manner when required. A tee is used at 14 instead of an ell, and the plug shown is taken out once each year. As the threads are thoroughly coated with graphite mixed with oil, it is not a difficult matter to remove this plug, and the opening thus provided permits an examination of the internal surface of the blowoff pipe. It is evidently much safer to ascertain the condition of the inside of this pipe, than to wait until one or more defects show on the outside. If the end of a pipe where it is screwed into a tee, is not corroded, the rest of it will probably be in a safe condition, if not more than 5 or 6 ft. long.

Figure 2 illustrates the blowoff pipes for another battery of boilers. A medium pressure gate valve (which would have been considered a high pressure a few years ago) is installed at 2 with an asbestos packed plug cock about it at 3. The globe valve, 4, and the check valve, 5, are in a drip line that takes all water from a 10-in. header, and returns it to the boilers automatically. Gate valve 6 admits cold water to fill the boiler after it has been cleaned and inspected. When this boiler is to be blown down, valve 2 is opened wide, after which plug cock 3 is slowly opened by means of a wrench. When the water level is lowered to a satisfactory point, 3 is slowly closed, and when shut tight 2 is closed.

A battery of 3 boilers was fitted up as above described, 13 yr. ago. It is operated about 10 months per year. On one of the boilers, 2 began to leak after 10 yr. service, and was replaced by another gate valve of the same design. The others have remained tight to the present time. The main blowoff pipe of this battery has never become corroded, nor shown signs of failure during this long term of service, although it connected directly into the main line shown in Fig. 1.

A tee is used at 7, Fig. 2, and the plug is also removed when the boiler is inspected, thus affording means for examination of the internal surface of the pipe.

W. H. WAKEMAN.

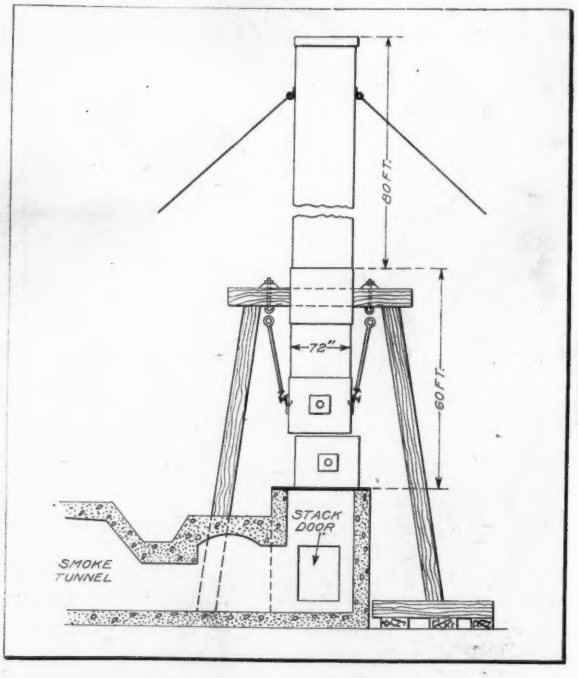
Repairing Hole in Pump Casting

REFERRING TO F. J. McDonald's pump repair job on page 743 in the Aug. 1 issue of Practical Engineer, I think I can go him one better. My pump, which is a 5¼ by 3½ by 6-in. with 2-in. section and 1½-in. discharge, gave out in the front end or next the steam end. The valve opening after removing the valve seat was 2¾-in. and the port into the cylinder about ⅝ or ¾ in., too small and crooked to get a bolt in or screw on a nut. We needed the pump badly, however, and it was up to me to try something. I cut, reamed and tapped a 2-in. pipe hole in the outer casting and through this put a ¾-in. pipe size drill which reamed the hole in the valve chamber round. Then put in a ¾-in. pipe tap, tapped it and screwed in a ¾-in. pipe plug with a hollow square in the end of it instead of the usual square head. Since both cylinders were in the same state, I treated the other the same way, only the second took a 1-in. plug to cover all the worn part. Screwed 2 2-in. pipe plugs in the outer casting and connected up. The pump is still giving good service, although this was done 3 yr. ago. The pump is a Buffalo duplex. F.

Raising of Large Metal Stack

RECONSTRUCTION of some of the power plants in the field, presents difficult problems.

The following with the illustration presents one of the raising of a large metal stack. Two of these stacks were in operation, and located close to surrounding buildings, they were 80 ft. high and 6 ft. in diameter. It was found necessary to increase the power of the boiler plant, and by so doing, the stack capacity had to be increased, so it was decided to add 60 ft. to the stacks,



METHOD OF RAISING A METAL STACK

which were erected on stack bases connecting to a common smoke tunnel. These bases and tunnel were brick masonry, having good stack base plates.

The plate, of which the original stacks were made, would not be heavy enough to permit putting the extra length on the top, so it was decided to raise the stacks by adding extra sections to the bottom. In order to do this, some provision had to be made for the raising and holding of the stack while adding the extra sections. A strong bench trestle was made and arranged so that 4 chain hoists could be used for the lifting. These were

mounted somewhat in the manner shown by the sketch, but in order to lift the stack without collapsing it, stiffening plates were securely riveted on the bottom section of the old stack so that the special hooks could catch in a small hole left on this plate, and after lifting and securing, bolts and washers were used to close up these small openings.

When a lift was made the guys were let out by means of a small chain block which was inserted in each guy wire close to its anchorage. All these appliances were set in place ready for work, everything being carefully secured ready for hoisting. The foreman got up where he could see the entire force and had his men well organized, each one at his post, when the order "hoist" was given, all hands worked their blocks together. When the proper lift was made for the allowance of a section that was ready it was hoisted in place and set beneath the stack first secured by several bolts and then riveted up, the workmen entering by the stack door.

When things had been made ready, it required but a short time to raise the stack the 60 ft. needed. Of course, extra guys were provided and placed as the stack was being raised.

C. R. McGAHEY.

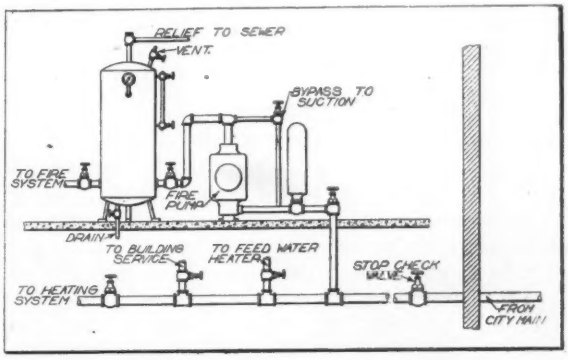
Novel Pump Connections

THE POWER PLANT with which the writer is connected is located in a large institution in the center of the city, and has to depend entirely on the city service for its water supply. The water system in the streets in the vicinity of this building has been in use for many years, and at times has given trouble, or new connections have been made, in which case it is sometimes necessary to cut the water off the building for a few hours while the connections are being made. As a rule, in a plant of this kind, a large tank is placed in the roof, which is supplied with water by a house pump; but in this case, it was considered unnecessary and was omitted. All the water is taken directly from the city service through a 6-in. main line with a gate valve just inside the building wall.

The building is only 4 stories high with an area 350 by 680 ft., and the city pressure supplies water to the top floor. The building contains 50,000 sq. ft. of hot water radiation, a complete cold water service system, a hot water service system and the fire system. Whenever the water is to be cut off by the water department for repairs, usually made at night, to the street system that supplies the building, the water department notifies the engineer at what hour it will be turned off, at which time the valve on the main line is closed. This makes it necessary to take the feed water supply from the water system of the building. It is first taken from the cold water service system, which contains approximately 7000 gal. After the supply in this system is exhausted, the hot water service, which contains about 3000 gal., is used. This usually has been found sufficient to last until the service is restored again, and will supply the boilers for 7 or 8 hr.; but in case it will not last until the service is restored again, the water in the fire system is used. This system holds about 6000 gal., besides the surge tank at the pump, which contains 1300 gal. more. In case this is not enough, the heating system will furnish some 12,500 gal. more. This gives a total of approximately 30,000 gal. of water available for boiler feed in case of emergency, and it is possible to drain the system entirely, as far as automatically admitted or vented.

This supply is sufficient to furnish water for the boilers about 60 hr. except when the heating system is not in use, as all of the condensation from the live steam heating system and also from the exhaust steam used in the hot water heating system heaters is returned to the boiler. These emergencies occur about once or twice a year, and so far have never lasted over 8 hr. at a time. As a guard against the water in the building system being drained, through accident to a pipe line or other causes, a stop-check valve or a stop valve and a check valve should be installed on the main line to the building. This is equally true of any building that has to depend entirely on the city water supply. This will prevent the system being drained unknown to the engineer.

As first installed, the fire pump had no bypass from the discharge to the suction line, and whenever the water in this system was to be used for the boilers, the pump



PIPING TO WATER SUPPLY SYSTEM

had to be cut out and drained and some of the discharge and suction valves removed to permit the water to flow back into the main line. The addition of a bypass at this point makes this unnecessary, and is also of value for other purposes. As the fire system of the building is under 50 lb. pressure from the city service, the fire pump is not kept in operation; but in case of fire or fire drill, it is operated to boost the pressure to 120 lb. This pump is the only one in the plant, outside of the feed pumps, that will supply cold water at a high pressure, and it is operated to furnish pressure to the boiler tube cleaner when drilling out scale. When not in use for any of these purposes, it is run about ½ hr. twice a week to keep it in good working order. Before the bypass was installed, when running the pump to limber it up, it was necessary to open a valve to the sewer, as the pump is controlled by a pump governor; but now it is bypassed back into the suction line, which saves considerable water.

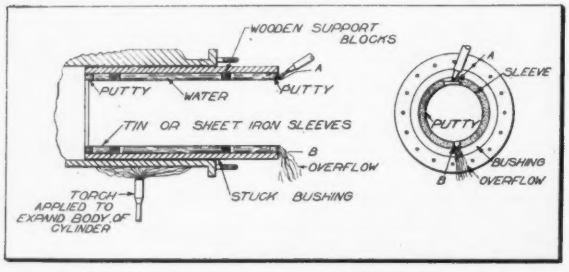
When the pump was first installed it gave considerable trouble from water hammer when running, caused by the surge tank being entirely full of water. The pump was stopped and the valves on each side of the surge tank closed, and the tank drained with the vent at the top open. When the water was all out, the drain was closed, also the vent, and the water turned on again,

and the air compressed in the tank. This gave a cushion of about 3 ft. in the top of the tank, which is 5 ft. in diameter by 10 ft. high, which cushioned the pulsation of the pump and prevented water hammer in the line. This entrapped air, however, is soon absorbed as the exposed surface to the water is great, and it is necessary to snift in air through a plug in the air chamber (not shown) with the water suction valve partly closed and the pump running at slow speed. In this manner, air can be supplied to the tank when needed. With a system arranged in this manner the entire cost of a separate house pump and tank was saved, and the fire pump is made use of for other than fire protection. During the 6 yr. that the plant has been in operation, there has always been sufficient water at the required pressure for all purposes. In a building many stories high, however, this system would not be satisfactory, as the pressure from the city service would not be great enough to force the water to the top floors, and a separate house service would be necessary. In plants where a roof tank is used for the house service, it would be well to have the other parts of the water system of the building so arranged that in case of an extended interruption to the water supply there would be enough water at hand, and available for boiler feed, to permit of operation for several hours. J. C. HAWKINS.

Removing a Cylinder Bushing

AN OLD 16-in. cylinder bushing was recently removed from the cylinder of an engine in a wood-working and sash factory. The new bushing was turned and started into the old cylinder body, being drawn in by a bar and bolt yoke thrown around the front end of the cylinder. When the bushing was nearly ⅔ of the way in, it became stuck and could not be gotten one way or the other without damaging the bushing.

The bushing was removed, however, reduced slightly in size to overcome a small irregularity in the front of the cylinder body and again successfully drawn into



METHOD OF KEEPING BUSHING COOL WHILE EXPANDING CYLINDER WALL

place without the least damage to the bushing. A piece of sheet metal was rolled into a cylinder about 1 in. smaller than the diameter of the bushing inside. Wooden blocks about ½ in. thick were tapped in to hold the sheet metal in place. The ends were puttied up with the exceptions of openings A and B, the one at B being a trifle smaller, forming a water jacket through which cold water was kept continually circulating by means of a small hose. The exterior of the engine cylinder was then heated by means of 2 moderately sized blow torches. The bushing being kept cool and of the same size through the action of the water in the improvised jacket, soon became loose and was readily withdrawn. It was reduced a trifle in size and successfully drawn into place.

The writer has seen a number of expensive bushings spoiled on mishaps of this nature, but there are many instances where this method of removing an obstinate bushing can be used to advantage. F. W. BENTLEY, JR.

Snifter Valve on Pump

IN Practical Engineer for Sept. 1, I note an article by Karl Hoffman, in which he writes regarding troubles he had with a simplex pump.

Mr. Hoffman's own statements in this article are the best arguments that could be put forward for the installation of simplex pumps. This pump, as stated by Mr. Hoffman, was installed to handle the condensation from the heating system, and working on this service Mr. Hoffman does not state that the pump gave any trouble whatever. As stated in his article, this pump was required to handle double the amount of water for which it was originally installed and the pump worked satisfactorily after an air chamber had been attached.

If Mr. Hoffman had put a snifter valve in the lower end of the water cylinder where holes are tapped for drain cocks, it would not have been necessary for the engineer to drain the air chamber as plenty of air would have been provided by the snifter valve.

The writer takes issue with Mr. Hoffman with regard to the statement he made that a duplex pump would have been preferable for the service. If the duplex pump had been speeded up in the same proportion as the simplex pump, the duplex pump would have had a tendency to short-stroke to a considerable degree, and there is no doubt but that the duplex pump would have made considerable more noise running on the higher speed than the simplex pump; and on account of the multiplicity of parts in the duplex pump, its life would have been very short. J. H. ROSEBERRY.

Why I Subscribe

THE TROUBLE with most of us is that we do not regard technical papers in the right light. We do not aim to make them SERVE us so much as to make them amuse us. Whenever we run across something that looks uninteresting on the surface we are inclined to call the article "dry" and uninteresting, and therefore do not read it. As a result, we may dub the whole paper as being "dry."

I endeavor to make technical papers my "employes." I hire them at a very low rate per year and through them I receive the counsel of high-salaried men—superintendents, managers, owners, etc. It would be virtually impossible to get advice from such men in any other way; yet, in this way, I have them all working for me.

For the few dollars expended in this way per year, I get many dollars in return; and besides, I have the pleasure of communing with the men higher up—those men who are where I aspire to be. I am aware of the fact that unless I do about as they do, learn their methods, and where possible beat their methods, I shall never get there. N. G. NEAK.

Questions Answered and For Answer

Expert Help When In Trouble. If You Want Quick Answer Enclose a Stamp

Some Questions and Answers on Refrigeration

EXPLAIN THE DIFFERENCE between ice melting capacity and ice making capacity.

2. Why are extra short coils objectionable in a direct expansion system?

3. Is there any limit to the length of direct expansion coils?

ANSWERS

ICE MELTING capacity is the heat absorbing power of melting ice. The latent heat of ice is 143.5 B.t.u. By this we mean that to melt one pound of ice the heat required is equal to 143.5 B.t.u. To melt one ton, 2000 times 143.5, or 287,000 B.t.u., are required. This is equal to one ton refrigerating capacity. An ammonia compression which is capable of pumping the vapor given up by the liquid ammonia which has absorbed 287,000 B.t.u. in 24 hr. is called a one-ton refrigerating machine. Then a one-ton refrigerating machine is one which is capable of doing an equal amount of heat absorbing duty as is performed by the melting of one ton of ice from and at 32 deg. F. In actual practice, when ice is used to cool produce in a room or box, the heat absorbed will amount to something more than 287,000 B.t.u., according to temperature of the room. In a room or box held at a temperature of 45 deg. F., the water itself will absorb heat till it reaches the temperature of the room. In this case, each pound of water will take up 13 B.t.u. after the ice is melted. Then the actual refrigerating capacity of a ton of ice melting in this room will equal 313,000 B.t.u. The theoretical refrigerating effect of one ton of melting ice is equal to 287,000 B.t.u.

The ice making capacity of a machine is the capacity it has for handling the ammonia necessary to evaporate during the process of producing ice from the available water and lowering the temperature of the ice to the temperature of the brine in the ice tank. The ice making capacity of a machine will vary according to the temperature of the water used for filling the ice cans in different plants and locations. The water from which the ice is made cannot be any colder than the coldest available cooling water unless the machine is used to lower this temperature. So all heat taken from the water (below the temperature of the cooling water) is absorbed by the ammonia which has to be handled by the machine.

Take, for example, a plant where water at 60 deg. F. is used. The temperature of the water is first lowered to 32 deg. F., requiring the withdrawal of 60 minus 32 or 28 B.t.u. per lb. of water. To convert a pound of water at 32 deg. F. into ice at 32 deg. F., calls for the removal of the latent heat, which is 143.5 B.t.u. So, not counting any loss of any kind, it takes 143.5 plus 28 or 171.5 B.t.u. to make a pound of ice at 32 deg. F. from a pound of water at 60 deg. F.

To make ice making a profitable business, the ice must be made quicker than it is possible to make it at 32 deg. F., so the brine temperature carried is about 14 deg. F. To lower the temperature of one pound of 32 deg. F. ice to 14 deg. takes $(32—14) \times 0.5$, or 9 B.t.u. (specific heat of ice is 0.5), therefore to make one pound of ice takes 180.5 B.t.u. To produce one ton will require 180.5×2000, or 361,000 B.t.u. But in ice making there is a constant loss due to heat leakage through the ice tank insulation, open lids, uncovered pipe work and inserting of cans which have a temperature of the atmosphere of the tank room. All such losses will amount to from 10 to 30 per cent depending on the condition and construction of the plant. If we take 15 per cent as the general average in a fair plant, it will add a little over 27 B.t.u. to each pound of ice or will make a total of 415,150 B.t.u. taken up by the ammonia in the making of 1 ton. Under these conditions the ice making capacity is about 70 per cent of the refrigerating or ice melting capacity.

2. When a coil is short, there is always trouble with the proper regulation of the ammonia through the expansion valve. The valve must be very little open to prevent too much liquid entering the coil and passing to the compressor. When the coil is short, the liquid will not all be evaporated and the compressor will get slugs of it which will cause freezing up and knocking in the cylinder. When the expansion valve has to be kept so nearly closed, it will become blocked with the particles of oil which are circulating with the ammonia. A coil should always be long enough so that enough heat absorbing surface is exposed to cause the evaporation of the liquid admitted through the expansion valve without the adjustment of the valve being so close as to cause trouble by becoming blocked.

3. Yes. Coils can be too long and so cause loss of refrigerating capacity at the compressor. To make this plain, the ammonia table must be referred to. Ammonia vapor occupies more space at higher temperature with the same pressure. At 20 lb. gage pressure and 6 deg. F. temperature, a pound of vapor will occupy about 8 cu. ft. At the same pressure, but at a temperature of 40 deg. F., the gas will occupy about 9 cu. ft. per lb. This example is not extreme. Take a cold-storage warehouse where certain goods are stored in rooms where a temperature of 40 deg. F. is maintained. If the coil is longer than necessary, the ammonia will be evaporated long before the outlet is reached. After the vapor has left the liquid, it becomes superheated and by the time the outlet of the coil is reached, the vapor will have become

a superheated gas, as it will have the same temperature as the surrounding atmosphere. This gas is light and occupies more space than the saturated vapor at the same pressure. If the compressor is working only on rooms that have a 40-deg. F. temperature, a higher back pressure is carried and economic operation is obtained. As a rule, however, there are only a few rooms requiring this high temperature and most of the cold storage is held at a temperature that requires a back pressure of 20 lb. or less. For this reason, the warm rooms should contain short coils so that the ammonia can be sent through them and to the main suction line at a temperature corresponding to the back pressure which it is necessary to maintain for the colder rooms.

For rooms held at 40 deg. F., the coils should never be over 500 ft. long, and in practice about 300 ft. is found best where the room is kept closed a greater part of the time. This rule applies to coils in rooms where a back pressure of not over 20 lb. is carried on the suction.

For cold rooms, long coils are the best as the distance the ammonia has to travel gives it a chance to vaporize at the low temperature. Coils of 2000 ft. of 2 in. direct expansion piping are found to give good service in freezers where a temperature of below zero is required. With a 2000-ft. coil in a zero room, it is possible to operate the ice machine with a back pressure of about 10 or even 12 lb. At 12 lb. pressure there will be a temperature difference of about 4 deg. F. between the ammonia in the coil and the atmosphere of the room. This is enough difference when the square feet of coil surface is large when compared with the size of the room. With such long coils in cold rooms the expansion valves should not be left open all the time. They should be shut off and the unevaporated ammonia in the coil given a chance to evaporate, as it will do when the feed is stopped and the pressure slightly reduced. Any long coil in a cold room will gradually become too flooded if it is not pumped down frequently.

A. G. SOLOMON.

Increase of Cutoff

I AM OPERATING a Rice & Sargent compound engine and at times the peak load is so heavy that I cannot hold up speed. What changes shall I make to obtain a longer range of cutoff? Eccentrics set at 90 deg.

A. From the information at hand it is difficult for us to make, perhaps, the most helpful suggestions that would be possible with more information.

Any Rice & Sargent engine should be capable of approximately 75 per cent cutoff while still under control of the governor. This would be theoretically impossible with any engine if it were simply laid out on paper from the 90 deg. position of the eccentric. It is, however, easily possible on account of the time limit in the dropping of the dashpot and closing of the valve, and almost any modern Corliss engine will do this without any trouble. All of our Corliss engines will accomplish it, with the possible exception of a few engines having high-pressure cylinder either 16 or 18 in. in diameter, built about 10 yr. ago, which for some reason never would give quite so late a cutoff as the majority of engines.

We should say that the first thing to do would be to check up the setting of the governor rods. The latch and toe steel should just barely miss when the governor is in its highest position. This will give the longest possible cutoff if there is not some disarrangement somewhere.

Sometimes it is possible to help a little by filing down the stop so that the governor at its lowest position will be a little lower but still not go down to the safety position.

PROVIDENCE ENGINEERING WORKS,
W. P. ALEXANDER.

Neutralizing Inductance

HOW DOES capacity in a transmission line affect the phase relation between the electromotive force and the current? If a line has self-induction, what device could be used to correct this trouble?

2. If a certain object is 20 ft. from a source of light, how many times will the illumination on it be reduced at a distance of 60 ft.? A. A. L.

A. The effect of capacity on transmission line is to cause the current to lead the electromotive force. If, however, such a system has a highly inductive load and it is desired to correct this so as to bring the power factor up to, or nearly up to, unity, the use of a synchronous motor, either floating on the line without load or partially loaded, will, when its field is over-excited, correct this condition. By the proper adjustment of its field, the power factor may be varied so as to be lagging, unity, or leading, as desired.

2. From the study of illumination, we know that the intensity of light varies inversely as the square of the distance, so that a given intensity at 20 ft., is to the intensity at 60 ft. as 60 squared, or 3600, is to 20 squared, or 400. In other words, if an object at a distance of 20 ft. from the source of light is supplied with an intensity of 1, an object placed 60 ft. from this same source will have an intensity equal to the following proportions: 1 is to x as 60^2 is to 20^2, or 1 is to x as 3600 is to 400.

Solving for x, we will have the product of 400 times 1 divided by 3600, or 0.111. Therefore, at 60 ft., the intensity will be just 1/9 of that which it is at 20 ft.

O. H. H.

Dry Kiln Trouble

WE HAVE just installed a 10-hp. vertical boiler for furnishing steam for our dry kiln when our other boilers are down. This boiler is fired with gas delivered by a 2-in. line coming from the meter. The kiln is to be kept at 160 deg. F. with 3 lb. pressure. A motor-driven receiver pump takes care of condensation and returns it to the boiler. I don't know just how much radiation we have in the kiln; but the boiler seems too small, as we cannot get over 2 lb. pressure. How many square feet of radiation can this boiler care for?

J. S. S.

A. There is considerable disagreement as to the amount of radiation which can be cared for by a boiler.

For house heating boilers, this runs from 900 to 1100 sq. ft. of radiation per rated horsepower, and for boilers of the power type, the radiation will run from 800 to 1200 sq. ft. per horsepower.

I assume that on a system of this kind, you would have a gravity return from your kiln coils to the boiler; but I should suppose that unless you have a very great excess of heating surface connected, you ought to be able to get the pressure up to 3 lb. without any difficulty. It would almost seem that there must be steam leaks or some other reason why the boiler is not able to live up to its opportunities. A. L. R.

Radiation Loss Determination

IN THE plant in which the writer is employed, 2 250-hp. Keeler water-tube boilers are used. The outside, or setting, opposite the first and second gas passes, is always hot. How are the radiation losses due to such conditions determined? What is the cause of the hammering in the check valves on boiler feed lines? R. C.

A. There is only one way to determine the radiation losses from a boiler, and that is, making a complete boiler test, accounting for all possible heat, and the balance is charged up as radiation losses. We know of no way by which it is possible to determine by direct test the loss due to radiation through a boiler setting.

In regard to the hammering of check valves in boiler feed lines, this is usually due to a feed pump which is running too fast, so that the reversal at the end of the stroke is very sudden. If the pump valves do not seat quickly, the result is that pressure from the boiler tends to back into the pump and hammers the check valve on the seat. Of course, if there is anything which sticks the check valve open at the reversal of the pump, such as friction or binding of the stem or pivot, so that it stays until the pressure has decreased considerably on the pump side, and then closes quickly, a hammering effect will be produced. A. L. R.

Ohio Examination Questions

BELOW IS a list of questions asked a recent applicant for an engineer's license in the State of Ohio:

1. Under what conditions can a boiler 60 in. in diameter withstand the same pressure as a boiler 48 in. in diameter, the shells of both being of ⅜-in. plates?

2. What is the difference between plain and submerged tubes?

3. What is the difference between a tube and a pipe?

4. Is there any difference between the angularity of the connecting rod of a horizontal engine and that of a vertical engine?

5. Name 5 advantages the Corliss steam engine has over a common slide-valve engine.

6. Why are 2 eccentrics used on a Corliss engine?

7. Is the steam pressure the same in all parts of a boiler?

8. Why and when are fire cracks dangerous?

9. When does the piston of a steam engine travel the fastest?

10. What are the advantages of suspending a steam boiler by hangers?

11. What would the effect of having too little lost motion in the valve stems of a steam pump? What would be the effect with too much lost motion?

12. Should a steam line be inclined toward the engine or toward the boiler?

13. What are the 3 most important things to be considered when piping a steam plant? What provisions must be made for expansion?

14. Which produces the greater strain on a steam boiler, the steam pressure or the change in temperature? Why?

15. Does the steam pressure produce greater strain upon the boiler plates and tubes than the cold water pressure? If so, why? Which is the more injurious? Why?

16. How does the water circulate in horizontal return tubular and horizontal water-tube boilers? How long does this circulation continue?

17. How are horizontal return tubular, horizontal water-tube and B. & W. boilers set?

18. Where are water columns generally placed on horizontal and vertical boilers?

19. Why is the water cylinder of a steam pump made longer than the steam cylinder?

20. If the piston rod on a duplex steam pump broke, how would you repair it and avoid shutting down the plant? Assume having no other means of getting water into the boiler.

21. What would you do with a duplex pump, one of the pistons of which was continually striking the cylinder head?

22. How would you determine whether the plunger or piston of a steam pump leaked without opening the cylinders?

23. How can you determine the condition of a check valve without taking it apart?

24. What is the effect of unbalanced air pressure on water?

25. How high can a pump lift water?

26. What 3 advantages are derived by employing condensers in connection with steam engines?

27. What changes are necessary when changing an engine from non-condensing to condensing? Why?

28. May an ordinary slide valve be termed a balanced valve? What is the difference between balanced and unbalanced valves?

29. What is the difference between angle of lap and angle of lead?

30. What is the relative position of eccentric to crank?

31. How is piston displacement calculated?

32. How would you measure the length of a connecting rod, neglecting the old one?

33. If you discovered the water out of sight in your gage glass and you had a high steam pressure and heavy fire in the furnace, what would you do?

34. Steam enters an engine cylinder at a pressure of 300 lb. and leaves at 200 lb. What is the drop in heat in B.t.u. equal to?

These questions have been sent us by F. Ustach, of 2348 Professor St. S. W., Cleveland, O., who states he would be pleased to have some of our readers answer them for him.—EDITOR.

TIME AND material are strewn along the avenues of waste, but these avenues are provided with check valves which prevent wastes from being returned to their origin.

PRACTICAL
ENGINEER

Trade-mark, Reg. U. S. Pat. Off.

PUBLISHED THE FIRST AND FIFTEENTH OF EACH MONTH
BY THE TECHNICAL PUBLISHING CO.
537 South Dearborn Street,
CHICAGO, ILL.

New York Office, 150 Nassau St.

Notify us at once of any change of address, giving the old and the new address, so that your paper may always reach you promptly.

Copyright, 1915, by Technical Publishing Co.

Entered as second class matter May 1, 1908, at the Post Office at Chicago, Illinois, under the act of March 3, 1879.

Circulation of this issue, 22,500.

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The Engineer and His Organization

Why is an organization? It takes time, money and work to keep one going. If the organization can do nothing except what the individuals alone can do as well, the organization is not justified.

But not in numbers is strength; also from much counseling comes wisdom. A man needs companionship, comrades in his calling, for inspiration, for sympathy, even for argument, to test the rightness of his ideas. And for the good of his profession as a whole, the engineer needs organizations to impress the world with his numbers and their importance.

Any organization, to be justified, must benefit its members. But the benefit that a member derives is mostly in proportion to the effort he gives and the interest he takes in meetings. Merely having his name on the list of members is of no great advantage to anybody, no matter how renowned the organization may be.

To secure results, cooperative action is essential; without united action and harmony any organization is but a collection of individuals. It will have no vigor or endurance. A man to become a real part of an organization must, then, lay aside petty jealousy and selfishness and learn to give in on small matters for the sake of agreement on large ones.

What and how many organizations are worth while? Those which have a real benefit to confer, and so many as are actually needed to care for the various interests of engineers.

Any organization which has a considerable membership and has existed for a long period may safely be assumed to meet a need, whether its field is educational, material or social. A proposed or newly formed organization must be regarded as on trial and to prove its right to exist will have to show that it has a worthy object, and probably that this object cannot be accomplished by already existing organizations, or that they will not make the attempt.

Every engineer has something that he wants to accomplish for himself that can be better done by cooperative activity than alone. He can get farther himself and, at the same time, help the rest along. Besides, he owes such cooperation to the profession, which by its existence, makes his job possible. The thing is to pick that organization whose aim or aims coincide with his. Then give it whole-hearted support for the good of himself and his profession.

Multiplying organizations for the sake of creating offices for men who like to hold them, or because some are not eager for all that a present organization is working for is bad policy and poor economy. The fellow who is in dead earnest can make any object for which he is working, a prominent one in the activity of a society of which he is a member. And he will have the weight of its standing and accomplishment in other directions to back him and those working with him for his particular purpose.

It's a good time of year, now when associations, societies and clubs are starting their winter meetings, to get into harness and pull with the other engineers for that thing you want most.

Engineers at Columbus

THIRTY-THIRD ANNUAL CONVENTION OF THE NATIONAL ASSOCIATION OF STATIONARY ENGINEERS

ALTHOUGH the big national convention did not open until Tuesday morning, there was a curtain raiser in the form of the Ohio State Convention which occupied the greater part of the time during Sunday and Monday. There were over 40 Ohio engineers who attended this convention and a good share of them remained over for the national affair and a closer inspection of the mechanical exhibit.

Special trains began to arrive Monday afternoon and evening, and by the time the convention opened Tuesday there were in attendance nearly 400 delegates. Most of us stopped at the Chittenden Hotel and the reunion which took place was to me one of the most interesting parts of the convention. All the business of the association was carried on in the Chamber of Commerce Building, except the opening meeting, which was in Memorial Hall, where the booths of the various manufacturers displayed the power plant machinery and accessories.

L. C. Ziegler, chairman of the local convention committee, called the opening meeting to order at 10:30 on Tuesday morning, and welcomed the convention in behalf of the local association and introduced Governor Willis, who welcomed the visitors on behalf of the State of Ohio. He congratulated the local committee on the splendid gathering of men and women, about 1200 in number, which they were able to bring together at this time and complimented the exhibitors on the highly creditable mechanical exposition. His remarks were quite general, but showed his appreciation of the services of engineers, and further stated that he admired the N. A. S. E. because it had always put human life above the dollar by urging that the incompetent shall not be permitted to jeopardize human life. Also because it stood for the better development of the resources of the nation.

National President Ray responding to the governor, expressed his appreciation for the warm welcome extended and stated that he knew a splendid time awaited all fortunate enough to attend the convention. He then outlined the efforts of the N. A. S. E. to elevate the engineer and the engineering profession. These activities were many, but principally along educational lines.

Mayor Karb received the visitors in behalf of the citizens of Columbus and gave us one of the most enthusiastic and interesting addresses of the convention. Starting out in a humorous vein, he soon got down to the serious topics of his address, urging all engineers as soon as they got a license to join the N. A. S. E., in order to keep abreast of current progress and be leaders in their profession. He then spoke of the early developments of Columbus, the donations of the early citizens for public buildings and contrasted conditions with the present-day facilities, such as transportation, schools, churches and public engineering works. He also described briefly the filtration plant, the municipal electric plant and the garbage disposal plant, and urged all who had the opportunity to visit these institutions because they were up-to-date and possessed many points of interest to power plant engineers. The garbage plant alone, he stated, earned for the city last year the sum of $72,000.

In his response to the mayor, National Vice-President Damon assured him that he would never regret having welcomed the convention, and in a brief manner pointed out what was being done by the N. A. S. E.

W. P. Tracy, President of the Chamber of Commerce, was then introduced and congratulated the organization on its high principles and character of its membership. Through the efforts of this association in connection with other organizations, he said a better understanding had come regarding the relations between employer and employe.

FIG. 1. WALTER H. DAMON, NEW PRESIDENT OF THE N. A. S. E.

Past National President McGrath, responding to Mr. Tracy, told of the early formation of the N. A. S. E. and how ever since that time its income had been spent for the cause of making the engineer of more value to himself, to his profession and to his community.

At the close of these opening exercises, President Ray assumed the chair and appointed the convention committees.

We were then turned loose to inspect the exhibit and secure luncheon before the afternoon session which convened at 1:30 in the convention hall, but first had the official photograph "took," including delegates, exhibitors and ladies.

PRESIDENT'S ANNUAL REPORT

IT WAS at this meeting, after the Credentials Committee had made its report, that National President Ray gave his address, which showed that he had been working diligently and formulated a number of ideas which, if put into practice, would undoubtedly prove of great benefit to the association. In part, Mr. Ray said: "We have 'weathered the storm' of a year of business depression with a good increase in membership, a won-

derful interest in educational work and an energetic campaign for license legislation in 11 states. After paying some $4000 indebtedness left as a legacy from last year, we are in good financial condition.

"We have expended less than $500 for educational work this year, yet never in the history of our organization has there been more active work done, as will be shown by the reports of the National Educational Committee.

"There has been great use made of the lantern slide lectures, many of the associations having carried on an active campaign independent of the plan of the National Committee.

"The only part of our work that has apparently failed has been the "Question and Answers" competition. Cash prizes were offered for the best answers to these questions. Only 10 members sent in answers, showing a woful lack of interest.

"There is an opportunity open at this time for the introduction of a new educational feature which I believe to have considerable merit, and I recommend its careful consideration to the delegates. It is as follows:

FIG. 2. J. A. KERLEY, VICE-PRESIDENT

The International Correspondence Schools of Scranton, Pa., are prepared to furnish special courses of construction at reduced prices to members of our organization, these courses to be handled just the same as their correspondence courses. The only stipulation is that we, as an organization, must adopt a more permanent policy in educational matters, so that they would be assured of a continuous plan from year to year.

"To place our educational committee on a more permanent basis it should consist of 5 members to be appointed one each year with one retiring each year.

"No new laws were enacted this year, dealing with the license of engineers or boiler inspectors. New legislation was introduced in 11 states, but none of these efforts was successful. The reason for failure is attributed to a lack of public sentiment in support of our legislative measures. This year we have expended nearly $1500 for new legislation and accomplished nothing except to keep the question before the public in a legislative way. Our efforts were spread out too thin. The same amount of money expended in Indiana or Illinois in one year before election would secure a new law.

"In order that provision may be made for our activity next year, a Ways and Means Committee was appointed early in July with instructions to prepare a budget covering our expenditures for next year. This report would cast no reflections on past administrations nor would it have you believe that I fear for the future. The only thought is that we ought to do business in a businesslike way and place the responsibility of expenditures of our resources where it properly belongs. The national convention should exactly specify, as nearly as may be, how every dollar is to be spent.

"The American Society of Mechanical Engineers has, after some 3 yr. of committee work, a boiler code governing the manufacture of boilers and other pressure vessels. Many states will, at an early date, adopt this code and we can be of invaluable assistance as individuals and as an organization in securing its enactment. An effort is being made to raise a fund of $12,000 to secure the adoption of this code, and I recommend that we contribute to this fund not more than $500 for this year.

"The boiler code and license law legislation should be presented to the legislatures as separate measures in order that each may be tested on its merits and neither be hindered by the opponents of the other measure. The imperative need of such a code and its universal adoption must be evident to all.

"Some 19 state associations have held state conventions this year and all were well attended and resulted in much good to our membership. The co-operation of the Exhibitors' Association is appreciated by every one having to do with state conventions and I would recommend to those state conventions which have not yet affiliated with the Exhibitors' Associations that they earnestly consider the matter, for there can be no question but it is to the interest of the state conventions to have this co-operation of the exhibitors.

"There is an imperative need for a good booklet setting forth the aims and objects of our organization, one designed especially to be used in propaganda work. We should have a goodly stock of them on hand at all times in the national secretary's office and a few with the association secretaries. These should be for free distribution. Not less than 30,000 copies should be printed."

At the close of his report, President Ray made the following recommendations:

1st: That a budget of expenses be adopted, covering all expenditures for next year.

2nd: That the per capita tax be increased to 80 cents per member.

3rd: That $2000 be appropriated for legislative work, $500 of this for preliminary work where needed, and $1500 in one state where there is a fair chance of success.

4th: That $4000 be appropriated for educational work as follows: $800 of this for an Information and Advisory Department; $500 for prizes; $200 for sundry expenses and National Education Committee; and $2500 for the manufacture of lantern slides.

5th: That the National Educational Committee be empowered to enter into a 5-yr. agreement with the International Correspondence Schools, for a series of

special courses of instruction suitable for our membership, at no cost to our organization, but the cost to be borne by individual members.

6th: That the National President appoint a special committee to compile and have published a booklet that will be a full and complete exposition of our organization, suitable for propaganda work, at a cost of not more than $400 for 30,000 copies.

7th: That the National President be empowered to spend not more than $500 for the introduction of the Boiler Code if, in his judgment, it is needed.

8th: That the sum of $1000 be appropriated to pay the expenses of deputies working under the direction of the National Deputy.

9th: That this convention adopt a resolution stating that all unused appropriations shall revert back to the general fund, the same as if they had never been appropriated.

National Deputy W. H. Damon reported that, during the past year, 12 new associations had been instituted with a total membership of 224, and that 8 associations had been reinstated with a total membership of 128. He reminded us that the deputy cannot do his work unless he has some funds behind him as he cannot be expected to pay his own expenses. He is of the opinion that the national deputy should have a fund to draw from so that when a state deputy wants to visit some of the weak associations he will not have to refuse to have him go on account of lack of funds.

National Secretary Raven then presented his report, a copy of which had been given to each delegate when he registered. It is in booklet form and covers expenses for supplies and printing accounts, checks drawn, in whose favor and for what amount, membership report by states, list of stock and property and valuations by item, associations having more than 100 members, associations gaining more than 20 and more than 10 members, new associations, reinstated associations, associations consolidated, and charters returned.

It showed that the total receipts for the year had been $30,807.16, all of which had been turned over to the national treasurer. In the 292 associations which sent in annual reports, there is an active membership of 19,562.

The report of National Treasurer S. B. Forse shows there is a balance in the bank and in the protection fund of $16,394.40.

Educational Work

The National Educational Committee then presented its report describing in considerable detail the activities during the past year and giving an appraisal of property in its hands, also presenting recommendations and suggestions as conditions seem to the committee to warrant and experience dictates. It was a lengthy report touching every phase of the educational work of the association and showed discouragement in regard to the prize competition which has been carried on during the past year in the way of a series of questions for which prizes were given for the best answers received. "Strange as it may seem," the committee states, "the theories which have sometimes been applied to our educational features were shattered and out of our 20,000 membership only 10 were entered in our prize competition, a much lower percentage, in fact, than in former years when questions submitted were of a more advanced nature.

"There is evidently a demand that further illustrated lecture material be provided, and fortunately the committee have at present in various stages of completion 3 sets of lecture material, namely, Locomobiles, Elevators and Corliss Valve Gears.

"Owing to the activity of central station solicitors, which has a tendency toward the grouping of many small plants under a single management, the committee, as well as others to whom it has been suggested, believe that the national committee would meet an ever-growing need by creating and maintaining a power data bureau. The function of this bureau would be to gather, compile and distribute data on unit cost items from power plants in various localities, mill plants, cotton thread, shirt and garment, steel and wire, cement, machine tools, novelty shops, etc., hotels, department stores, apartments, block plants, refrigeration warehouses, ice plants, central stations, etc. For each locality the prevailing central station rates should be filed so that comparative costs might be actually known. This bureau should be capable of serving isolated plant committee."

In regard to the information department the committee stated that owing to conditions which were beyond its control it was forced to discontinue the information department this year. Members who had plant problems to solve and expected aid from this source were, greatly to their disappointment, told that they would have to seek for other sources of information.

The report of the License Committee was an interesting story of the efforts of the committee to get license laws through the legislatures of the various states where the laws were presented. In California, Delaware, Illinois, Indiana, Kansas, Maine, Michigan, Minnesota, Pennsylvania, Texas and Washington license laws were presented, but in each case met with failure, either dying in the committee, failing to pass both houses of the legislature or vetoed. It is stated that aside from extending the scope of its influence and getting some publicity the national association has made no gains that would extend the safeguarding of life and property to additional territory.

After the committee had presented its report, delegates interested in license legislation were invited to meet the license committee and go over prospective campaigns and also study the pamphlets offering suggestions for that class of work.

That evening, while the ladies were enjoying a theater party, the men at the convention were entertained at a smoker by the National Exhibitors' Association at Memorial Hall after which a parade started and marched through the principal streets of the city. It had been a long and tiresome day and we were all ready to rest up for the big outing which was to be the next day.

Wednesday's Outing

From the Hotel Chittenden special electric cars took us to Indianola Park, starting at 10:30, and before the regular program of athletic events were witnessed, those in the park enjoyed usual recreation features. Athletic events, by land and water, for fun and in earnest, commenced on the baseball field at 2 o'clock, and were

planned to take in everybody who attended, prizes being given to the winners. The big event of the afternoon was the baseball game between teams of the engineers and exhibitors. The result of this game was 18 to 7 in favor of the engineers, which put them in good humor for the return trip.

Thursday morning we listened to a paper by Edward H. Kearney, entitled "Steam Boilers." In his introductory remarks the author called attention to the importance of a steam boiler to industry and spoke of the complete control which men now have over the force of steam under pressure.

He then took up briefly the history of steam boilers, followed by a description of types and a discussion of water circulation, some comment upon boiler design and a word of warning in regard to feed water and scale. The effects of oil in boilers were described briefly and the paper closed with a talk on combustion of fuel.

Committee reports then took our attention for the rest of the session, the most important being the Board of Arbitration, Committee on Referendum, Board of Trustees' Report, and at 11 o'clock the officers of the National Ladies' Auxiliary visited the convention and were welcomed by President Ray. The ladies gave a report of the work which they had been carrying out all through the past year, and asked for the further co-operation of the N. A. S. E. in looking after the needs of the worthy unfortunate members of the association.

The annual memorial services were then held in respect to the members who had passed away during the past year.

During the afternoon session the report of the Ritual Committee was heard and after this several of the president's recommendations were acted upon by the convention. The recommendation that "a budget covering all expenses for the year be adopted" was carried and the per capita tax was fixed at 70 cents instead of 80, as recommended; $4000 was voted for the educational work, and the recommendation that all unexpended portions of yearly appropriations be returned to the general treasury was carried. The recommendation of the Educational Committee that encouragement be given the members to contribute papers, and that $100 in prizes be awarded for that purpose was carried. Also the recommendation that complete lectures be sent out with each set of lanterns was carried.

Following this business session, Prof. Wagner of Rose Polytechnic Institute read a paper on "The Place of the Steam Boiler in the Power Plant," emphasizing that while in the engine room the efficiency is dependent largely upon the design of the apparatus, in the boiler room it is due mostly to the conditions maintained in the furnace and the boiler by the operator. He pointed out the places where losses are apt to occur and how they may be cut down by a study of draft losses and flue gas analysis.

After the report of some of the minor committees and the official roll call the meeting adjourned until Friday morning. Thursday evening, however, the annual entertainment, under auspices of the National Exhibitors' Association was given in Memorial Hall, and afforded us a great deal of amusement as well as a real musical treat. Later in the evening the Chapman Valve Mfg. Co. invited delegates to a smoker in honor of Walter H. Damon at the Hotel Kaiserhoff, where prominent men in the power plant field spoke in high terms of Mr. Damon and prophesied a remarkably successful year for the N. A. S. E.

This closed the events of another long day of convention affairs and left only Friday for the completion of the work. The principal business of the morning was the election of officers. This resulted in the election of Walter H. Damon of Springfield, Mass., as president; J. A. Kerley of Cincinnati, Ohio, vice-president; Fred W. Raven of Chicago, secretary; S. B. Forse of Pittsburgh, Pa., treasurer; Wm. J. Bedard of Rochester, N. Y., trustee, to take the place of Mr. Kerley; and L. E. Engel of Des Moines, Iowa, doorkeeper.

The convention city for next year is Minneapolis, Minn., this choice being influenced largely by the extreme heat which was endured during the entire convention in Columbus. The regular business of the convention was then closed and a good many of the engineers made preparation to leave during the afternoon and evening. A goodly number, however, stayed to witness the installation of officers which took place at 8:30 in the evening and to participate in the grand ball at the Commercial Travelers' Hall, following the installation.

Among the Exhibitors

WITHOUT a mechanical exhibit a National Convention of Engineers would be like all work and no play and would be taking the majority of us out of our sphere of endeavor. While convention meetings have become largely business discussions without many papers, at the National Convention much education is supplied by the National Exhibitors' Association, whose representatives of various manufacturers describe the working features and improvements in the apparatus which they manufacture, and attract visitors to their booths by souvenirs.

While manufacturers generally have recognized the past year as one of business depression, a visit to the exhibit which was held in Memorial Hall revealed to anyone who has kept in touch with manufactured products that many improvements have been made in the details of power plant machinery and accessories during the past year.

It has been a comparatively short time since the principal use of graphite was for making pencils. In a talk with the men in charge of the U. S. Graphite Co.'s booth I learned that their Mexican mined graphite is used largely for feeding into boilers to remove scale, and mixed with greases of various constituency is used for the lubrication of bearings. One of the latest developments of this company, however, is a graphite paint which is used for covering metal surfaces of all kinds exposed to either high or low temperatures, being well adapted for boiler fronts and furnaces.

In the booth of the Armstrong Mfg. Co., of Springfield, Ohio, was exhibited a new type of underfeed stoker. This is of rather a novel design, employing air blast, shaking and dumping grates on either side of the horizontal retorts. The underfeed stoker has met

with wonderful success in burning bituminous coal in boiler furnaces, and this new type has features which would appear to give it distinct advantages. In addition to the stoker the Armstrong shaking grate bar was also on exhibit.

In the booth of the Lumen Bearing Co., the representatives were explaining the uses and efficiency of Lesoyl, a comparatively new lubricant for high grade bearings. Mention was also made of the new process which they employ for purifying natural graphite, which gives a superior quality for lubricating purposes and makes it especially valuable for applying to hot boxes.

Westinghouse Air Compressors, made by the Westinghouse Air Brake Co., were the pioneers in the railway field, and have been used widely in power plants, but recently this company has inaugurated a campaign to secure more of the power plant business and now has a line of compressors which are particularly suitable for furnishing compressed air for blowing purposes and other industrial work about a plant or shop. They may be either steam or motor driven, stationary or portable units. One of the vertical compressors was on exhibit in the booth of this company.

In the booth of Greene, Tweed & Co., particular attention was called to Palmetto Packing in 2 forms, braided and twist, to suit various requirements; twist for all small valves, braided round and square in solid form for layer upon layer construction, giving strength to resist the destroying power of high pressure steam. Another specialty, manufactured by this company is the Favorite reversible ratchet wrench, which is convenient for use in inaccessible places around a power plant.

"Save ⅓ of Your Cylinder Oil," was the attractive sign in the booth of the Oil Economizer Co., of Columbus, Ohio. The oil economizer is a device which may be used with either an oil pump or a hydrostatic lubricator. The object of this device is to emulsify the oil in condensate before it is atomized in the steam pipe leading to the engine. This process, it is claimed, increases the volume of the oil, making it more easily atomized so that it will cover the entire cylinder surface.

Nothing attracts attention like a working model, and by this means the Crane Co. demonstrated the use of its direct-return, lifting and non-return traps for feeding boilers. A 5-hp. gas fired boiler furnished steam, and after condensation the trap system returned the water of condensation to the boiler regardless of the temperature, which in this case was 250 deg. The pressure on the boiler was 25 lb. per sq. in. Besides the installation of Crane Tilt traps, the Crane Co. exhibited an auto stop and check valve, a Crane-Erwood auto stop and check, and a noiseless bypass valve, also a Crane pressure regulator.

The Mason Regulator Co. made a special exhibit of its reducing valves, calling attention also to the damper regulator, pressure regulating valves, etc. The diversified use of steam in an industrial plant has made the Mason products popular among isolated plant engineers particularly.

The Trill Indicator Co., of Corry, Pa., exhibited its sensitive instruments for taking both single and continuous diagrams. It is stated that these instruments will indicate engines running as high as 400 and 500 r.p.m. and give no trouble from the whipping of the indicator cord. One of the details is the use of a silver pencil which gives a distinct mark on special indicator paper furnished with the instrument. There are other refinements in the construction of these instruments which make them convenient, sensitive and accurate to a high degree.

In the booth of the Jefferson Union Co. were exhibited unions and flanges and pipe fitting specialties such as union ells, union tees, universal angle flanges, all having the Jefferson specialty of a brass seat ring.

In addition to Anderson horizontal and vertical steam and oil separators, Anderson traps and safety water columns, the V. D. Anderson Co., of Cleveland, Ohio, had on exhibit a working model of its pressure oil filter. This is a new filtering process by means of which the oil is passed through heavy filter cloth or filter paper in order to extract the finest particles of grit, so that the oil may be used over and over again indefinitely.

FIG. 1. LANE THOMPSON, PRESIDENT N. E. A.

At the booth of the Spencer Turbine Cleaner Co., Hartford, Conn., was shown the Spencer turbine vacuum cleaner with a special attachment for sucking the soot from tubular boilers. This is something new, and its work in actual practice will be interesting.

The products of the Standard Oil Co. are well known, but developments are continually going on and improvements being made to suit conditions which arise in improvements of machinery. In the samples of oils displayed were some which have been developed for turbine bearings working under high pressure. Another oil has been developed to be used especially in cylinders using super-heated steam. The need of these products has developed during recent years and only as the lubricant improves can the machinery develop in these directions.

The Ohio Grease Co., of Loudonville, Ohio, exhibited lubricators and superheaters for use with Ohio cylinder grease. The use of grease in steam cylinders has but recently been made possible by means of these superheaters and excellent results are claimed.

At the booth of the Toledo Pipe Threading Machine Co. the various sizes of pipe threading and cutting

machines were shown in operation. The latest development is the new ratchet No. 00 which threads and cuts pipe from ⅛ to ¾ in. and works easier than a pipe die. These are wonderfully convenient tools, making it possible to do pipe fitting of any size up to 12 in. right on the job, one man being able to operate the machine.

At the booth of the Federal Metallic Packing Co. we were shown the various applications of Federalite packing which is especially adapted to anhydrous ammonia, Corliss valve stems, centrifugal pumps and air compressors. The one fault (?) with this packing, we were told, is that it will wear almost as long as the machine on which it is used.

The Joseph Dixon Crucible Co. displayed its graphite products which consist of paint, belt dressing, pipe joint compound, flake boiler graphite, motor brushes, etc. Graphite is adaptable for use in many places about a power plant and the Dixon Crucible Co. has found them all.

The valves which Jenkins Bros. exhibited were of the old reliable type, brought up-to-date, but still kept reliable. The removable disc is still one of the principal features, this being employed on all types

FIG. 2. H. D. RAYMOND, VICE PRESIDENT AND SECRETARY

including the check valves. A full line of brass valves was displayed, also the iron body globe and gate valves. One of the recent developments was the automatic stop and check valve used for boilers.

At the Ashton Valve Co. booth we were shown Ashton safety and relief valves, pressure, vacuum and recording gages, electric alarm gages, testing outfits, whistles and bubbling fountains. All of these accessories have embodied the latest improvements in design.

The Walworth Mfg. Co. made a specialty in its exhibit of wrenches used about the power plant. These have the latest improvements to make them convenient to handle and can be used on highly polished fittings without marring the parts. The Farnsworth trap was also exhibited here. It is a tilting trap which may be used for lifting, pumping or metering, other styles being adaptable for use as vacuum traps, variable pressure traps and duplex boiler feed traps.

The Quaker City Rubber Co. had a complete display of Daniels' packing, which are known to have a good reputation by all engineers. The hose and auto tires which were also on display are among the newer products of this company and are upholding the reputation gained by Daniels' family.

New York Belting & Packing Co. showed its Turxo, Vulcan spiral steam packing and sheet packing, also other styles of combination packings for special purposes. Of all power plant supplies packing has apparently received the most attention during the past few years and the advance made in this direction is noteworthy in that friction and leakage have been reduced to a minimum.

The S-C Regulator Co. has made improvements in its continuous feed regulator, principally in the use of Monel metal seats and discs in the valves, which lengthens the life of the regulator. This company has also remodeled its gage cock, making it of brass and seatless, which does away with wear of the parts. Another product of the company is a piston rod lubricator which is meeting with favor.

In the booth of the Elliott Co. we were shown the latest methods for removing scale from boiler tubes by means of the Liberty tube cleaner. This is made with various types of cutting heads which may be driven by motor, steam or air pressure, whichever is available around the plant. We have also shown the latest types of steam and oil separators and blowoff valves.

The familiar trade mark of Albany Grease was conspicuously displayed at the booth of the Albany Lubricating Co., where samples of Albany grease were distributed to visitors and a demonstration of the latest product known as Cook's lubricant for auto gears was also made for the inspection of engineers who know a good lubricant.

The Lagonda Mfg. Co. makes a line of boiler room specialties, including tube cleaners operated by water, air or steam pressure, and in types for cleaning both water-tube and fire-tube boilers of scale. One of the especially convenient devices is that for feeding the cleaner into Stirling boilers, enabling the operator to remain outside the drum. Other specialties are the electric reseating machine for removing scale and rust from headers, caps and nuts of water-tube types of boilers, also Lagonda automatic cutoff valves and a 3 basket strainer for cleaning condensing and feed water.

The Peerless Rubber Co. showed in its booth rubber hose, packing, valve discs and gaskets. The famous Rainbow came in for its share of praise from the engineers as did also the Eclipse Special Rainbow Gaskets for steam boilers. For rods the Peerless Spiral, the Improved Peerless, Peerless square spiral, Peerless Packing in rings, are also favorites in the power plant.

The Keystone Lubricating Co. has recently developed what is called No. 2½, which is especially adapted for use in gear boxes of automobiles and the like. The regular line of grease made by this company was also on exhibit as well as Keystone grease cups which are of various designs to meet all conditions under which grease may be used.

The McDonough Automatic Regulator Co. has made some improvements in the detail of its feed water regulator which enables the removal of the entire valve disc, seat and stem without breaking pipe connections, also

by the addition of a small lever the engineer is able to fill the boiler rapidly without changing the adjustment of the regulator, which makes the device more convenient. An improvement made in the damper regulator is the addition of a bell-ringing transformer in plants where alternating current is available.

In the booth of the Flexible Steel Lacing Co., the attendant demonstrated how Alligator steel belt lacing can be applied to all kinds of belting material. Another product of this company is a recently developed lamp guard which was also on exhibit.

At the booth of the C. E. Squires Co. they explained the workings and advantageous features of the genuine Squires steam traps, for all pressure and vacuum uses.

A comparative demonstration was made at the booth of the Cling-Surface Co., between a treated and an untreated leather belt to show that the treated belt runs slack with less slip than does the untreated belt when under considerably higher tension. The demonstration was conclusive evidence of the value of Cling-Surface.

The Perolin Co. of America had on exhibit samples of scale which have been removed by the Perolin process, also explained the Pyro-Perolin process of removing scale. The company guarantees clean boilers by the use of Perolin used continuously after the Pyro-Perolin process has been applied to the boiler.

Attention was drawn to the Hoppes Manufacturing Co.'s booth by the working exhibit of the Hoppes V-notch meter with the improvements which were described in the Aug. 1 issue of Practical Engineer, making it highly sensitive throughout the entire range of its capacity. Attention was also called to the Hoppes feed-water heater, purifier, steam separator, oil eliminator and exhaust head.

The Lunkenheimer Co. called attention to its brass specialties, including valves, grease and oil cups, whistles, etc., and in addition showed cross sections of its large gate valves, high and low alarm columns, blowoff valves and its non-return safety stop valve.

At the booth of the Dearborn Chemical Co. visitors were told of the service given to its clients, enabling them to keep their boilers free from scale without injury to the boiler metal, no matter what kind of water is used, the treatment being varied to suit the special conditions.

The special feature of the H. W. Johns-Manville exhibit was the samples of work done by high temperature cement used for furnace settings. The most recent product along this line is a cement for covering the inside of furnaces to keep them from deteriorating. Other specialties on exhibit were J. M. Sea-ring packing, insulating material for all purposes, fuses and tapes.

The working model of the Copes boiler feed regulator in the booth of the Erie Pump & Equipment Co., attracted the attention of all visitors to the exhibit. It is an ingenious arrangement and is described more in detail on another page of this issue.

The Weinman Pump Mfg. Co. exhibited its single stage, motor and belt driven centrifugal pumps in its booth. These pumps are made for all purposes, including boiler feeding and are made in any number of stages.

The McLeod & Henry Co. demonstrated the use of its steel mixture for boiler settings by means of models. These blocks are made in special forms to fit boiler door arches, ignition arches, back arches and bridge walls as well as regular firebrick sizes.

Swartwout steam specialties made up the exhibit of the Ohio Blower Co., and included the rotary ball-bearing ventilator, the exhaust head and steam separator. The ventilator has undergone recent improvements which make it rust-proof and so delicate that it will shift with the slightest wind, drawing the air from the room below by suction created by the wind combined with a chimney action where a duct is used.

John F. Robertson Co. had on display a steam trap which is essentially of the bucket type, but when the valve is closing the bucket is given a rotation by the steam coming from the line and this gives the valve stem a rotating motion, seating it each time at a different point, so that should scale or sediment lodge on the seat it will be ground off.

In the booth of the Roto Co. several types of tube cleaners were mounted upon piping supplied with compressed air and a demonstration of the method of operation was given by the attendants.

FIG. 3. PAUL T. PAYNE, TREASURER

The Franklin Oil & Gas Co. exhibited a Franklin Cylinder Oil Carburetor which atomizes the cylinder oil in the feed pipe before it reaches the cylinder. In the sale of its oils, which are made for all purposes, this company makes special efforts to find out to what service the oil is to be put, then specifies the most economical grade for this purpose.

At the booth of the D. T. Williams Valve Co. the demonstration of the trap system for returning water to a boiler under pressure was the most interesting feature. The traps employed for this demonstration were the Cookson return trap, the working parts of which are, with the exception of the float, open to inspection at all times. Other specialties exhibited by this company were the Cookson Improved steam trap, a combined separator and trap, brass valves, oil cups and a recently developed automatic water gage.

The S. Freeman & Sons Mfg. Co., had on exhibit a working model of the Freeman internally fired continental design boiler which showed clearly the water

circulation through the water space of the boiler. There was also a large photograph in this booth of the new Deshler Hotel now being erected in Columbus in which Freeman boilers will be used.

In the booth of the McCord Mfg. Co. a working model was shown of the McCord force feed lubricator which was designed to lubricate a complete power plant from a central point. Other lubricators with 1, 2 and 3 feeds were also on exhibit and the noteworthy features pointed out by the attendant. McKim gaskets were also made a part of this exhibit, these being of soft copper shell enclosing red rubber or asbestos packing as the special use demands.

The Wm. Powell Co. displayed a full line of its specialties with sections cut out to show the important and distinctive features. Among the later developments of this company are the nonreturn valves and double-acting valves used on the leads from the boilers to the steam header. Regrinding is a feature found in nearly all Powell valves to increase their life and reduce leakage and in many cases double seats are employed. The Irenewo valve is another specialty of the Powell Co., having an iron body with special metal trimmings.

One of the new appliances at the exhibit was an automatic re-closing circuit-breaker, made by the Automatic Re-closing Circuit-Breaker Co., of Columbus. At present it is made only for direct current, but later will be adapted to alternating current also. The distinctive feature of this breaker is that after a short has occurred and the breaker thrown out, as soon as the line has cleared itself the breaker will close automatically. A time element feature, however, prevents the re-closing of the switch before the motor starting appliances have come to their starting position.

Officers elected by the National Exhibitors' Association for the coming year are: President, Lane Thompson, of the Lunkenheimer Co.; Vice President and Secretary, H. B. Raymond of the A. W. Chesterton Co.; Treasurer, Paul T. Payne of the Dearborn Chemical Co.; Executive Committee, Charles A. Wilhoft, New York Belting & Packing Co., T. C. Green, Garlock Packing Co., Charles Cullen, Wm. Powell Co., Horace A. Smith, Philadelphia Lubricating Co., and F. N. Chapman of A. Lescher & Sons.

Full List of Exhibitors

Following is a complete list of the firms represented at the exhibit:

Ashton Valve Co.; Anchor Packing Co.; American Steam Gauge & Valve Mfg. Co.; Anderson Co., V. D.; Armstrong Mfg. Co.; Arrow Boiler Compound Co.; Avery & Loeb Elec. Co.; Bowers Rubber Works; Bowser & Co., S. F.; Budd Grate & Foundry Co.; Builders' Foundry Co.; Chapman Valve Mfg. Co.; Chesterton Co., A. W.; Cling-Surface Co.; Cook's Sons Co., Adam; Crandall Packing Co.; Crane Co.; Dearborn Chemical Co.; Dick, R. & J., Ltd.; Jos. Dixon Crucible Co.; Dodge Sales & Engineering Co.; Durabla Mfg. Co.; Elliott Co.; Ellison, Lewis M.; Erie Pump & Equipment Co.; Emer & Hopkins Co.; Falls Machine Co.; Federal Metallic Packing Co.; Ferguson Publishing Co.; Flexible Steel Lacing Co.; Franklin Oil & Gas Co.; France Packing Co.; Freeman & Sons Mfg. Co., S.; Gardner Grate Co.; Garlock Packing Co.; Greene, Tweed & Co.; Hawk-Eye Compound Co.; Hills-McCanna Co.; Home Rubber Co.; Hoppes Mfg. Co.; International Acheson Graphite Co.; International Correspondence Schools; Jefferson Union Co.; Jenkins Bros.; Johns-Pratt Co.; Johns-Manville Co., H. W.; Keystone Lubricating Co.; Ladies' Auxiliary; Lagonda Mfg. Co.; Leschen & Sons Rope Co., A.; Liberty Mfg. Co.; Lunkenheimer Co.; Mason Regulator Co.; Mechanical Rubber Co.; Mining & Engineering World; Monarch Boiler Arch Co.; McCord Mfg. Co.; McLeod & Henry Co.; McDonough Automatic Regulator Co.; National Brake & Electrical Co.; National Engineer; New York Belting & Packing Co.; Ohio Blower Co.; Ohio Grease Co.; Ohio Economizer Co.; Otis Elevator Co.; Parkersburg Iron Co.; Peerless Rubber Mfg. Co.; Perolin Co. of America; Philadelphia Bourse; Philadelphia Grease Mfg. Co.; Potts-Seiders Supply Co.; Powell Co., Wm.; Power; Practical Engineer; Quaker City Rubber Co.; Restein Co., Clement; Richardson-Phenix Co.; Richardson Scale Co.; Roebling's Sons Co., J. A.; Ross-Willoughby Co.; Roto Co.; "S-C" Regulator Co.; Southern Engineer; Spencer Turbine Cleaner Co.; Squires Co., C. E.; Standard Oil Co. of Ohio; Standard Water Systems Co.; Simonds & Co., G. L.; Texas Co.; Toledo Pipe Threading Machine Co.; Travelers Indemnity Co.; Trill Indicator Co.; U. S. Graphite Co.; Walworth Mfg. Co.; Warren Webster Co.; Weiman Pump Mfg. Co.; Westinghouse Traction Brake Co.; Wickes Boiler Co.; Williams Valve Co., D. T.

News Notes

William E. Keily announces the removal of his office from 6503 Minerva Ave. to 72 West Adams St. (Room 1126), Chicago, Ill.

At a meeting of the Board of Directors of the Westinghouse Electric Export Co. in New York, held July 28, the following officers were elected: E. M. Herr, president; L. A. Osborne, vice-president; Calvert Townley, vice-president; Maurice Coster, managing director; J. C. Bennet, secretary; H. D. Shute, treasurer; F. E. Craig, auditor; W. H. Jones, assistant secretary and assistant treasurer.

In addition, the president announces the appointment of the following officers: E. D. Mills, manager; E. R. Ellis, European manager; H. F. Griffith, assistant export manager.

On Oct. 1 the Goulds Mfg. Co. of Seneca Falls, N. Y., will open a Philadelphia office at 111 N. Third St. The company has purchased the business of H. E. Trotman, who up to the present time has been distributor for Goulds pumps in this territory, and has leased from him the store-room and warehouse at the above address. E. S. Jenison, formerly with the Canadian Fairbanks-Morse Co., Ltd., Montreal, has been appointed manager and F. G. Kramer, formerly in the employ of H. E. Trotman, will be assistant manager. J. B. Trotman will continue with the Goulds Mfg. Co. This is the third office opened within the past few months by the Goulds Mfg. Co., an office having been opened in Pittsburgh on Aug. 1 and one in Atlanta on Dec. 1.

G. D. Bradshaw, Steam Engineer of the Cambria Steel Co., has tendered his resignation and on Oct. 1 will enter business for himself at Pittsburgh under the firm name of Andrews-Bradshaw Co. Mr. Bradshaw has been in the Steam Engineering Dept. of the Cambria Steel Co. for the past 5 yr. Prior to that time, he was employed by the Indiana Steel Co. at Gary, for one year, and by the Illinois Steel Co. of Chicago, for 5 yr.

The Andrews-Bradshaw Co. will engage in the sale of equipment to steam power plants and will represent several well known manufacturers.

Mr. Bradshaw will have associated with him R. W. Andrews who has had considerable experience in the sale of steam specialty equipment and who is well known throughout the Pittsburgh district. The qualifications and previous experience of both Mr. Bradshaw and Mr. Andrews are such as to insure their success in this new company.

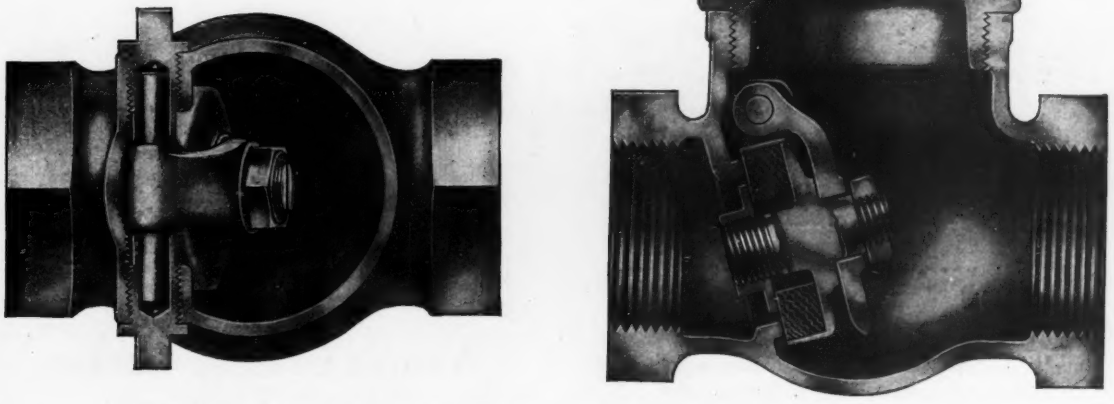
Power Apparatus in Shop and Market

New Ideas In Making, Buying and Selling

Jenkins New Check Valves

JENKINS BROS.' new Standard Pattern brass swing check valves, as shown in the cuts in cross section, have strong working parts and large bearings, contained in globe shaped bodies, combining strength with neatness. These valves are made from standard and extra heavy patterns in brass, iron body and cast steel. The design provides a handsome and durable valve with a full clear opening and practically no pocket at the bottom of the body.

They are provided with the Jenkins Bros. renewable disc feature. Valves used for hot water service as in boiler feed lines and returns are fitted with discs of tough semi-hard composition, and for cold water or air service are fitted with discs of soft pliable composition.



HORIZONTAL AND VERTICAL SECTIONAL VIEWS OF JENKINS NEW CHECK VALVES

The disc lifts well out of the passage when wide open, thus offering no more resistance to the flow than the best gate valve. Details of all working parts are well proportioned and of sufficient strength to ensure good results under severe conditions for long periods of time.

The hanger is heavy, has large bearing surface for carrying the disc-holder, and good solid striking points when thrown wide open. The hanger pin bearing is long, and provides ample wearing surface, the pin being carried and held in place by a long plug on each side of the body. The plugs have large square heads which makes removal easy. By unscrewing the cap and plugs, and removing the hanger pin, the complete inside working parts may be lifted out of the body and disc renewed when necessary. The valves work perfectly in either horizontal or vertical position.

Exhibit of Copes Regulator

IT IS a very difficult matter to show graphically the operation of a boiler feed water regulator; and especially to show the scientific relation existing between water level, steam flow, regulator control valve opening, and water input, under all conditions of load.

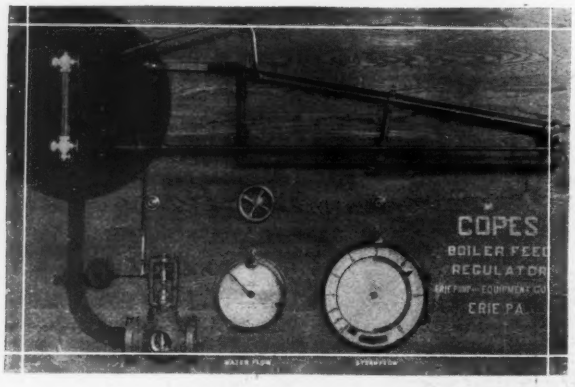
The accompanying photograph shows a clearly designed, and striking exhibit of the Copes boiler feed regulator, manufactured by the Erie Pump & Equipment Co., of Erie, Pa.

The exhibit board itself is of oak, measuring 8 by 5 ft., and supported 3 ft. from the floor by structural iron work. On the board is shown the drum of a boiler with water column and gage glass, and a full sized 2½-in. feed line entering the bottom of the drum. A Copes boiler feed regulator of standard construction is properly connected to the boiler, as in practical service, and a full sized 2½-in. flanged control valve is shown in the feed line. The feed control valve is cut open so as to show the valve construction and operation, a miniature electric bulb being cleverly inserted in the neck of the valve, fully concealed, but brightly lighting up the interior construction.

A full size indicating and recording General Electric steam flow meter indicates the load on the boiler, while Builders Iron Foundry Venturi meter of standard size shows clearly the water input. Above both steam and water meters are located auto dash-board electric lights clearly illuminating the dials. The manner in which the rise and fall of the water level is shown is especially

interesting. The water glass itself is of ground glass, 10 in. long by 7/8 in. wide, set in a slot in the board flush with the face. On the back of the board is a 25-watt tungsten light, which reflects on a housing of brilliant white, which in turn reflects and diffuses the light evenly through the ground glass. A metal slide, light-tight and operated by means of a cam and pulleys, gives an extremely life-like indication of rising and falling water level.

The entire exhibit is driven by an electric motor geared down so as to go through a complete cycle of load, water input, and water level variation once every 3 min. With a steady normal load the Copes regulator holds the control valve open so as to show an input of water exactly equal to the evaporation, and the water level remains steady at normal level. As the load suddenly increases, the water level is shown to increase slightly, and the regulator valve shuts down slightly, actually decreasing the amount of feed water entering the boiler. By decreasing the inflow of water just as an increase in load occurs, the furnace heat is available for making steam, instead of heating more cold feed water. As the load keeps on increasing, the water level gradually



COPES BOILER FEED REGULATOR MOUNTED FOR EXHIBIT PURPOSES

drops and the regulator gradually increases the feed. With maximum load conditions the water input is gradually increased to balance the steam output, and the water level is again held constant at any predetermined low level.

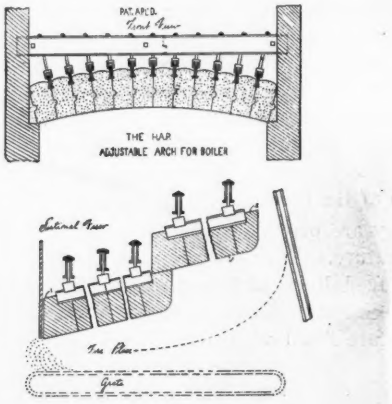
When the load decreases, the feed increases, and water level is gradually raised. This allows the furnace heat to be utilized by storing up the heat in a large body of water, which is available for instant use when heavy or sudden loads come on. The Copes regulator is shown to feed continuously as long as the boiler is generating steam, and the control valve is never wide open except at periods of peak load and never tight closed except during no load. The water level varies from a predetermined maximum at full load, to a predetermined minimum at no load. The entire operation of the Copes regulator is shown by this exhibit, exactly the same as in actual boiler practice.

This exhibit was shown at the N. A. S. E. convention at Columbus, Ohio. Those who wish may see photographs of the exhibit if they desire, as an attractive booklet has been published by the Erie Pump & Equipment Co., showing the operation by photographs.

Adjustable Arch for Furnaces

IN the building of arches for boiler furnaces, masons have been handicapped by certain mechanical difficulties which limit both size of arch and radius of curvature. To overcome these difficulties, as well as to prevent a sudden falling of an arch without notice, the H. A. P. adjustable arch has been devised and recently placed on the market by H. A. Paquette & Co., of Chicago.

The arch is built up of specially formed fire brick to fit any desired radius of curvature. Near the top edge of the brick, space and a groove are left so that the



H. A. P. ADJUSTABLE ARCH

lower flanges of a cast-iron I-beam are held firmly between 2 adjacent bricks. Cast-iron catch blocks slip around the upper flanges of the I-beams and through these, bolts of proper length extend to channel supports running across the top of the furnace; over the channels a plate is placed through which holes are drilled at the proper places to receive the adjusting bolts. By varying the length of the bolts and changing the location of the holes in the plate over the channel, an arch of any curvature can be secured.

Awards Granted Lunkenheimer Company

A SHORT time ago, articles descriptive of the Lunkenheimer Co.'s exhibits at San Francisco and San Diego appeared in these columns. That the Juries of Awards were impressed with the quality of the engineering appliances displayed is evidenced by the Medal of Honor which was granted the Lunkenheimer Co. at the Panama-Pacific International Exposition, and the Grand Prize at the Panama-California Exposition.

The exceptionally large and complete line of engineering appliances exhibited covers in great variety, bronze, iron, "puddled" semi-steel and cast steel globe, angle, cross, check, gate, balanced throttle and nonreturn safety boiler stop valves; also bronze and iron pop safety, relief and blowoff valves; water columns and gages; whistles, ground key work, injectors and ejectors; bronze fittings and unions; cylinder lubricators, oiling devices, oil and grease cups; automobile and motor boat specialties, etc.

Valve Name Contest

THE Homestead Valve Mfg. Co., of Homestead, Pa., announces that Thomas R. Tarn, of Division Engineer Department of Public Works, Pittsburgh, Pa., has won the prize offered for the best trade name suggested by any reader of Practical Engineer for its new gate valve. Several hundred names were suggested, most of them good; but some of these, although good in themselves, when investigated were found to be already in use on some other product; others were too long and complicated for the purpose intended. An interesting phase of the contest was the general approval given by all the engineers who studied the construction of this gate valve, most of them being enthusiastic on account of the many improvements.

The interest shown in the contest is highly gratifying to the promoters. The comments received from successful engineers all over the country would indicate that the "Nuway" Gate Valve will be given a good reception in the power plants and mechanical field. The company is not yet ready to sell these valves, but is at the present time designing, testing and making all necessary arrangements in order that usefulness and reliability shall be assured to users from the first. Announcement and full description of the "Nuway" Gate Valve will be given in these columns at a later date.

The letter which Mr. Tarn submitted gives some of the reasons of the contestant for selecting the above name, and will be interesting to all who took part in this contest.

"NEWAY is composed of the words new and way, in which the W is common to both words.

"Neway, I believe to be a new word well descriptive of your new valve. It is easily said, spelled and remembered. It has a distinctiveness about it which tends to convey the proper intent and a lasting impression.

"The present valves manufactured by your company are known as 'Straightway,' 'Three-way' and 'Four-way,' and in order that the old adage, 'Consistency, Thou Art a Jewel,' may be substantiated, it follows that 'Neway' bears out what might be termed a consistent naming of your products.

"It rhymes to good advantage, could be registered as a trade-mark and as a trade name it enters into a conversation with the least possible effort."

It will be noted that the spelling has been changed to "Nuway," as the company considered that this spelling would be more easily pronounced and recognized.

The Homestead Valve Mfg. Co. desires to convey its thanks to the engineers who took part in this contest for the time and attention given to the matter, and hopes that their interest in the "Nuway" Gate Valve will continue.

TO COMPREHEND a man's life it is necessary to know not merely what he does, but also what he purposely leaves undone. There is a limit to the work that can be got out of a human body or a human brain, and he is a wise man who wastes no energy on pursuits for which he is not fitted; and he is still wiser who, from among the things that he can do well, chooses and resolutely follows the best.—Gladstone.

Catalog Notes

HAMMOND WATER METERS are the subject of a new bulletin discussing their development, operation and advantages. The meters are manufactured by Alberger Pump and Condenser Co., 140 Cedar St., New York.

THE USE AND ABUSE of Ball and Roller Bearings is the title of a new 20-page treatise by F. J. Jarosch, Chief Engineer of the Bearings Company of America. The text gives explanations and experiences which help in the selection, mounting and lubrication of ball and roller bearings in automobile gears and in all other rotating parts and is intended to help in detecting the real cause of trouble. Nineteen drawings are used to illustrate the text matter. Mr. Jarosch contributes in a very practical way, valuable thoughts to a much discussed subject, and automobile engineers as well as many others who are interested in the subject will be glad to know that a copy of this treatise may be obtained free upon request from the publishers, the Joseph Dixon Crucible Co., Jersey City, N. J.

THE WILLIAM POWELL CO., Cincinnati, O., manufacturer of steam fittings and accessories of all kinds, has for many years past made a point of issuing at frequent intervals a series of booklets which not only illustrate its goods and list prices, but give details and particulars as well, not generally found in catalogs, thus obviating the necessity of writing the manufacturer for information. The latest of this series published is entitled The Powell Appliances for Automobiles, Trucks, Motor Boats, Gas, Gasoline and Oil Engines, and is, if such a thing be possible, an improvement over its predecessors. It is prepared with the usual painstaking attention to valuable details, is remarkably complete and well arranged, of a convenient size for handling and is clearly and distinctly printed on fine stock. Among the lines enumerated are the Powell Generator Valves, Gasoline Strainers, Priming Cups, Gasoline Cocks, Relief Cocks, Air Cocks, Hand Air & Oil Pumps, Multiple Oilers, Lubricators, Oil Cups, Grease Cups, Whistles, Whistle Valves, Brass Fittings, Unions, Needle Point Valves, etc.

The Wm. Powell Co. also manufactures a general line of valves and fittings for industrial plants.

CIRCULAR OF INFORMATION, 1915-16, lately received from Franklin Union, Berkeley and Appleton Sts., Boston, gives summaries of the courses, among which are Industrial Electricity, Civil Engineering, Industrial Chemistry, Steam Engines and Boilers, Machine Construction, Gasoline Engines.

CATALOG NO. 65 has just been received from The James Leffel & Co., Springfield, O., describing and illustrating Leffel steam engines and boilers. The details of construction and method of manufacturing many of the parts used in these engines are given, also tables showing the dimensions and weights of the various types of engines and boilers manufactured by this company.

BULLETIN 141, entitled "Methods of Constructing Large Capacity Deep Wells for Irrigation Pumping in the Great Plains" has just been received from the American Well Works. This bulletin tells, in an interesting way, the methods employed in this work, and

is profusely illustrated with cuts made from photographs of the various types of drilling machine outfits used in this work.

IN A FOLDER just received from the Ready Tool Co., of Bridgeport, Conn., is illustrated and described the Safety First Belt Shifter, which consists of 3 rollers, 2 being tapered in such a way as to disengage the shifter when the belt runs on the pulley, thus preventing accidents so frequent in the handling of belts.

WENTWORTH INSTITUTE, Boston, Mass., in its 1915-16 catalog announces day and evening, shop and technical courses, including instruction in Electric Wiring, Electrical Construction and Operation, Practical Mathematics, Mechanical Drawing, Steam Engine and Operation of Power Plants, Electrical Machinery, both Direct and Alternating Current. There are other courses, including practically all shop and building trades, and the mathematics and science which underlie them.

The catalog gives a complete description of the courses, and the equipment available for the instruction of students. It can be had by applying to Arthur L. Williston, Principal of Wentworth Institute, Boston, Mass.

THE GENERAL ELECTRIC CO. recently issued Bulletin No. 47,406, describing the company's Type F, From K-20 oil switch, which is for use on voltages up to 2500. These switches are built in 3 capacities: Non-automatic and automatic, for use on 2, 3 and 4-wire systems, and for current up to 300 amp. They are especially adapted for textile, flour and powder mills, woodworking plants, gas works, coal mines, and the pumping and refining of oil, and other industries where inflammable materials or explosive gases are present.

The bulletin contains illustrations and diagrams of the various styles of these switches.

"COMMERCIAL ORGANIZATIONS of the United States" is the title of a directory of which a new edition has just been issued by the Department of Commerce. The information has been collected by circulars sent out from Washington, with assistance from the Post Office Department, giving the most complete list of commercial organizations that has been issued. Copies may be obtained for 15 cents from the Superintendent of Documents, Washington, D. C.

THE WESTINGHOUSE Electric & Mfg. Co. has recently issued Leaflets 3805, 3806 and 3807 on the application of automatic control apparatus to cranes and steel mills. They show the scheme of main connections and describe the method of operation of the magnetic unit switches, as arranged for the severe service of steel mill practice.

BABBIT METALS is the title of a booklet just received from the Lumen Bearing Co., brass founders, of Buffalo, N. Y. In this booklet the various grades of bearing metals manufactured by this company are described, giving the characteristics of each and the principal constituents.

HOMESTEAD VALVE MFG. CO., Homestead, Pa., in its latest circular illustrates the Hovalco regrinding and renewable blowoff valve; also, double blowoff valves, a combination of the Hovalco and the Homestead quarter turn valve.

PRACTICAL ENGINEER

Trade-mark, Reg. U. S. Pat. Off.

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Position Wanted

POSITION WANTED—As Meter Foreman and Power Salesman. Have had nine years practical and technical experience. Thoroughly familiar with the requirements of the Public Service Commission of Pennsylvania. Address Practical Engineer, Box 405, Chicago, Ill. 9-15-2

POSITION WANTED—By man of good habits. Age 30. Technical education. 12 years machinist and electrician, 2 years engineer, 2 years salesman. What have you? Address Practical Engineer, Box 401, Chicago, Ill. 8-15-2

POSITION WANTED—By young man as oiler or fireman in a modern plant. I. C. S. graduate. Address Frank Knapp, 404 S. 5th St., St. Joseph, Mo. 8-1-3

POSITION WANTED—By engineer in medium sized power plant, or large coal mine. Have Illinois license; 7 years' experience with steam engines and boilers. Some experience with electricity. Good habits. References. 24. Illinois preferred. Address W. E. Rohline, Box 224, Farmington, Ill. 8-1-3

POSITION WANTED—By young man with 10 years' practical experience from boiler room up. Hold first class Massachusetts engineer's license. Will go anywhere. Am total abstainer and can furnish A1 references. Address Practical Engineer, Box 393, Chicago, Ill. 8-1-2

POSITION WANTED—Chief Engineer of wide experience solicits correspondence with large manufacturing concern in view of locating with same. Have U. S. Marine Engineer's License for Chief Engineer; License for Pittsburgh, Pa. First-class for State of Ohio. Am a teetotaler and require the same of my help as far as possible. Can furnish best of references from present employers. Address Box 403, Practical Engineer, Chicago, Ill. 9-1-1

POSITION WANTED—By man 26 years of age. Have had 28 months' experience as general man around stationary power plant, and 2 yrs. running traction engine; also hold fireman's license. Reference will be furnished to any one wishing to correspond with me concerning a position. Address Geo. M. Bucey, 1614 O St., Lincoln, Nebr. 9-15-1

POSITION WANTED—By engineer in medium sized power plant or assistant in large one. Have third class Ohio license. 5 yrs. experience with both Horizontal Tubular and Water Tube Boilers and steam engines. Some experience with electricity. Good habits. Sober, 26 yrs. old. Good reference furnished if necessary. Address Emmet R. Ralston, Lock Box 212, Cheshire, Ohio. 9-15-1

POSITION WANTED—Stationary Operating Engineer, age 27 years, quick learning and a hustler wants position with a Mechanical or Electrical Engineer or Concern, with chance for advancement. Address Practical Egnineer, Box 407, Chicago, Illinois. 10-1-1

Help Wanted

WANTED—Resident subscription agents in the following cities: Atlanta, Ga.; Cincinnati and Columbus, Ohio; Kansas City, Mo.; Los Angeles, Calif.; Louisville, Ky.; Newark N. J.; New Orleans, La.; Portland, Ore.; St. Louis, Mo.: San Francisco, Calif.; Washington, D. C. This is an excellent chance for a hustler, who is familiar with power plant conditions, to turn his spare time into dollars. To such a one we offer a Real Opportunity. Write Subscription Department, Practical Engineer, 537 S. Dearborn St., Chicago, Ill. tf.

FREE ENGINEER BOOKS and power plant tools and specialties for securing new subscribers to Practical Engineer. A dandy chance for the engineer with a little spare time to get some fine premiums. Send for free descriptive circular and terms. Address Practical Engineer, Subscription Department, Chicago, Ill.

REPRESENTATIVES to cover territory more thoroughly. Boiler-room necessities; liberal commissions; old-established house. Apply by letter. H. F. Maurel, 534 West 22nd St., New York City. 7-15-6

HELP WANTED—Opening for refrigerating engineer, one who has had experience in oil refinery work, 200-ton York machine and gas engine. Address National Refining Company, Coffeyville, Kans. 10-1-1

Wanted

WANTED—Agents handling engine and boiler-room specialties in every section for side line paying large commissions. Give experience, line carried, and territory covered. Address Practical Engineer, Box 381, Chicago, Ill. tf.

WANTED—Agents on commission to sell our Shaking Grates. We will install grates on trial or put in on test at our expense with any grate made. Address Armstrong Mfg. Company, Springfield, Ohio. tf.

CHEMIST with experience as efficiency engineer in boiler house wanted. Good education and experience needed. State fully age, married or single and salary expected. Address Practical Engineer, Box 402, Chicago, Ill. 8-15-6

WANTED—Engineers and Salesmen to demonstrate and take orders for Pulle-Y-Grasp during spare hours on commission. Send for sample. Address Desk P. E., Cardinal Mfg. Co., Cleveland, Ohio. tf.

For Sale

FOR SALE—Engines: 16x36 Buckeye medium speed automatic engine. Overhauled, $350. 14x24 Murry slide valve throttling engine, $150. 13½x15 Taylor automatic slow speed engine, $200. 10x24 Hewes & Phillips Corliss engine, $275. 16x30 Allis heavy duty Corliss engine, practically new, $750. 150-hp. HRT boiler, 125 lb. steam pressure, $400. DUZETS & SON, Hudson Terminal Bldg., New York. tf.

FOR SALE—(Model) Corliss Engine castings, cylinder 2"x4½". Ask for circular. F. L. Peterson, 14 Bourne St., Worcester, Mass. 10-1-1

FOR SALE—25 hp. steam engine and boiler with all the equipments. Write H. Murray, Goodland, Ind. 10-1-1

Patents and Patent Attorneys

PATENTS C. L. Parker, Attorney-at-Law and Solicitor of Patents. Patents secured promptly and with special regard to the legal protection of the invention. Handbook for inventors sent upon request. 186 McGill Bldg., Washington, D. C. tf.

PATENTS THAT PROTECT AND PAY—Advice and books free. Highest references. Best results. Promptness assured. Send sketch or model for search. Watson E. Coleman, Patent Lawyer, 624 F St., Washington, D. C. tf.

PATENTS—H. W. T. Jenner, Patent Attorney and Mechanical Expert, 606 F St., Washington, D. C. Established 1883. I make a free examination and report if a patent can be had, and the exact costs. Send for full information. tf.

A. P. CONNOR, Consulting Electrical and Mechanical Engineer. Attorney-at-Law and Solicitor of Patents and Trade-Marks. Results guaranteed. 121 Carroll St., S. E., Washington, D. C. tf.-x

PATENTS—Send sketch for free search and reports. Books on patents and book of reference letters sent free. John S. Duffie & Co., 612 F St., Washington, D. C. tf.

PATENTABLE IDEAS WANTED—Send for three free books. R. B. Owen, 28 Owen Bldg., Washington, D. C. tf.

Education and Instruction

ENGINEERS' POCKET MANUAL; 175 pages; gilt edges; bound in leather; edited by University of Tennessee; will be mailed every subscriber sending in one NEW subscription (not your own) to Practical Engineer.

Miscellaneous

ENGINEERS, DO YOU WANT to utilize your exhaust steam for heating or drying purposes, without back pressure on your engine? If so, address Monash Engineering Co., 1413 W. Jackson Blvd., Chicago, Ill.

Inventions

INVENTIONS commercialized on cash and royalty basis. Inventors and manufacturers should write Adam Fisher Mfg. Co., 2175 Railway Exchange, St. Louis, Mo. tf.

Sparks From The Advertising Pages

Business Is Steadily Becoming Cleaner, More Upright, More Honest

It is idle to question whether it is the head or the heart of business that is dictating closer adherence to the principle of "honesty the best policy." The important matter is that the principle is being more widely recognized and more consistently followed.

Advertising has responded to this impulse toward cleaner methods of business. Very naturally so, for advertising is a true mirror of business conditions and practices.

The movement for the elimination of fraudulent, dishonest and misleading advertisers, progresses briskly. Uncle Sam, through the post office department, keeps a watchful eye on violations of the laws bearing on fake propositions, and advertisers are working together in an effort to suppress lying and misrepresentation in advertised offers.

The circle of fraudulent advertisers is gradually contracting and embraces today mostly the "fly-by-night" species of business men, for it requires but little intelligence to perceive that the man who intends to stay in business cannot afford to make misstatements. Retribution for the falsifying advertiser is sure and sometimes swift. Truth-telling is the only paying policy.

The efforts of advertisers to make advertising clean are being ably supported by all first-class publications. Indeed, in many cases the movement has gone beyond the mere exclusion of dishonesty, exaggeration and misstatement. Many publishers have placed some lines of advertising on their black list, because in their opinion the advertising of certain propositions does not conduce to the public welfare.

The rigid censorship of the advertising columns with a view to the exclusion of unreliable offers has two advantages to the public. It saves their money and it saves their time.

The buyer, in the modern complexity and variety of commodities, is often in no position to protect himself in a purchase. It is here that the press can and does frequently help him by refusing to put before him offerings which do not give a fair return for his cash.

Then, also, this conscientious attitude of the press toward advertising is a big advantage to the buyer in saving him time and trouble. To respond to an advertisement and receive information showing that a commodity is not all what the buyer wants, is not so serious as losing money in a straightaway purchase, but it is none the less a vexatious experience.

Readers of **Practical Engineer** can feel absolutely sure that its advertising pages present no offer that is not absolutely on the square, and that when they spend their time in the investigation of advertisers' claims it is time well spent.